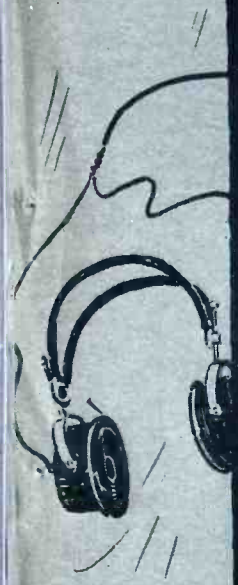
SEVENTH YEAR OF SERVICE

RADIO ENGINEERING

Vol. VII FEBRUARY 1927 Number 2



Review of Transmitter Developments

An illustrated account of new equipment for commercial and broadcast transmission

Design Data for A. F. Circuits

Working data for the design of A.F. amplifying circuits, with performance curves

Socket Power Super-Heterodyne

The first design for a super circuit using seven 201-A's and power tube operated from A.C.

Operating Characteristics of Rectifier Tubes

Data on the 216-B and 213 rectifiers, the 874 glow tube, and the ballast tubes

Trend of Radio Power Devices

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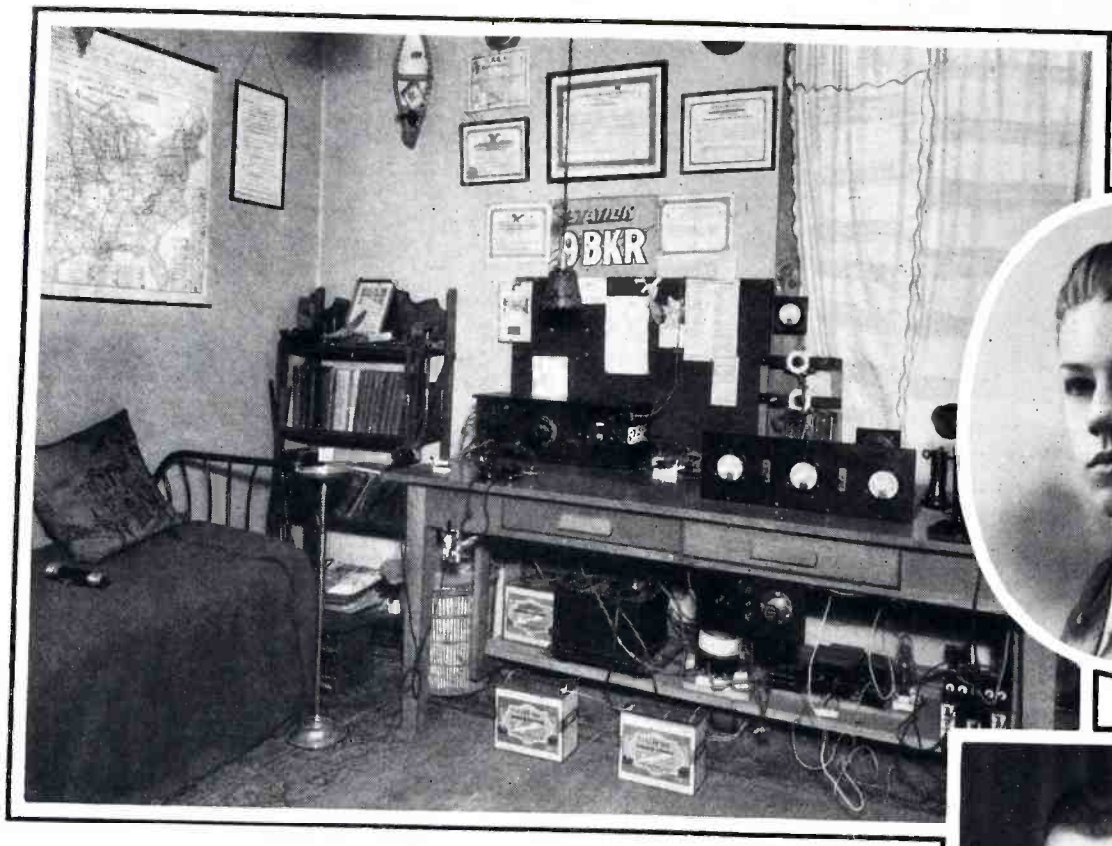

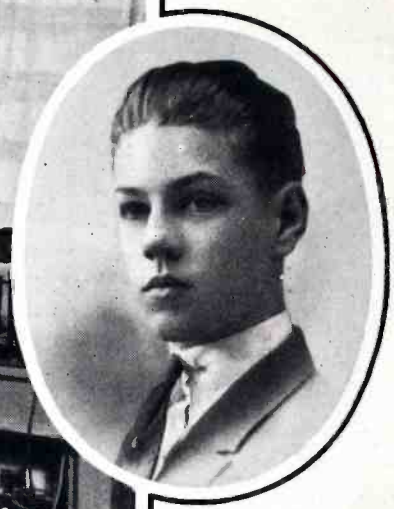

Mr. J. M. Meyer

Mr. Fred Catel, *President*
Milwaukee Radio Amateurs' Club, Inc.

9BKR at Milwaukee Show used Eveready Layerbilt "B" Batteries

All who worked 9BKR during the week of the Milwaukee Radio Show, September 25th to 29th, know what a pure DC note that station transmitted. It was heard from New York City on the east to California on the west, in practically continuous operation daily from 2 to 10.30 P. M., handling an immense amount of traffic to all points in the United States.

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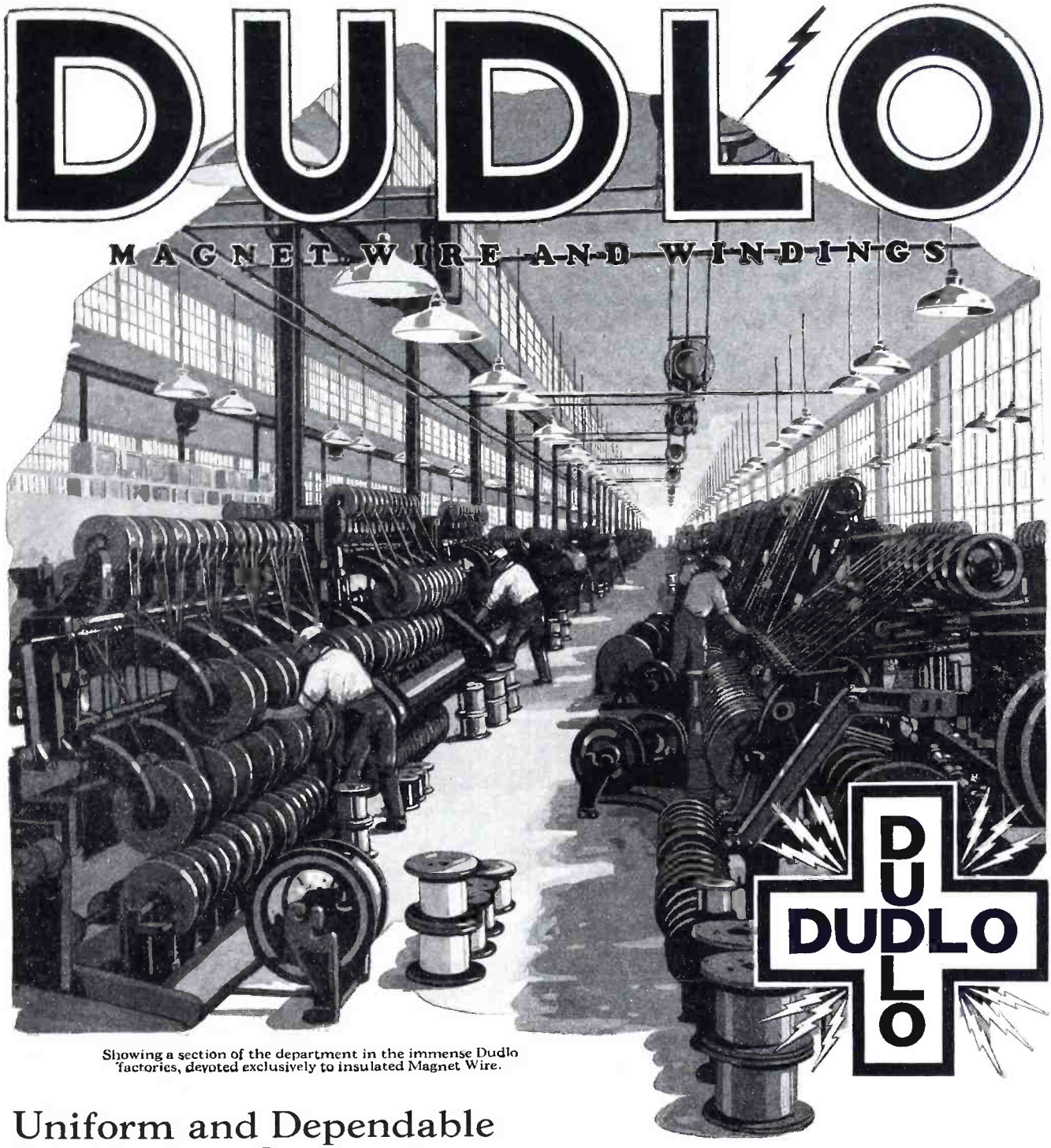

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EDITORIAL

FOR all the effort that is being made to put thru corrective and constructive radio legislation at Washington, it is generally conceded that very little can be accomplished within a year's time. That points to another season lost to the radio industry, for air conditions that hampered sales this season are growing more serious from month to month.

The number of stations on the air, at one time showing a decrease, is now rising at an alarming rate. Meanwhile, radio manufacturers and the public are helpless against the concerns who, oblivious to the wishes of R. C. L.'s, are blindly selfish in their ambition to get on the air.

Is there any solution for this situation which can be worked out by the sales and engineering departments of the radio manufacturers?

It seems that one method can be found in the laboratories if it can be sold first to the sales and advertising managers—namely, to develop sets for next season in which the degree of radio frequency pick-up is reduced, and audio frequency amplification increased.

Just as the long wheel-base, once a distinguishing feature of fine automobiles, is now considered a liability rather than an asset, so we may find high sensitivity frowned upon in radio sets—also as a result of traffic conditions.

Right at the time when the public had become educated to the point of being satisfied with good local reception, we find that sets are so sensitive that distant stations heterodyne with locals.

Modern sets are too sensitive for modern conditions. It appears, then, that a loop receiver, preferably of the uni-directional type, followed perhaps by one or two strainers designed to give sharpness without R.F. amplication, and high audio amplification, will provide the most satisfactory reception.

Three or four years ago, when our knowledge of A. F. amplification was most elementary, the useful degree of A. F. amplification was limited by tube noises, transformer distortion, and low power tubes. This brought about a demand for R. F. amplification.

Today, high R. F. amplification contributes little more than interstation heterodyning, and ready response to man-made static. On the other hand, distortionless A. F. amplification is available to almost any degree. We have adequate power tubes which can be supplied from A. C. current sources, and very fine A. F. circuits.

Our engineers can develop, during the summer, equipment which will meet what will probably be worse conditions this fall more satisfactorily than present designs are able to handle conditions now prevailing—provided that the sales managers can be made to understand and appreciate what they must do in order to sell radio reception which will be worth buying.

There may be other methods. We cannot count on legislation. Selectivity has been brought to the limit of A. F. quality. Certainly the owners of unwanted stations will not close down. No developments in transmitter design are immediately available that will eliminate or even reduce interference. It appears, then, that corrective design must be engineered into receiving sets, and sold to the public thru highly intelligent advertising and sales methods.

M. B. SLEEPER, *Editor*.

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Edited by M. B. SLEEPER

Managing Editor, HOLLIS de NEEFE

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Seventh Year of Publication

CONTENTS

In the March Issue

Full circuit data and constants will be given for a totally regulated B supply and power amplifier in Radio Engineering for March. The design of this unit incorporates many new and desirable features not hitherto applied to power supply equipment. The output of this device is constant under all conditions, and is independent of line or load.

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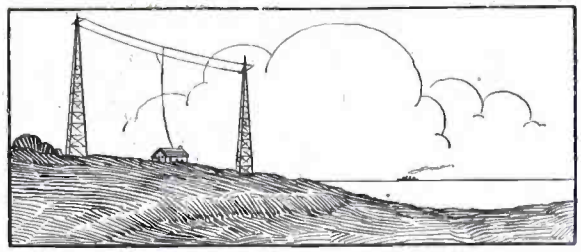


DEVELOPMENTS IN TRANSMITTING EQUIPMENT DURING 1926

*A review of data gathered in connection with the transmitting branch of radio development—By John Liston**

THREE vacuum-tube radio transmitters, each rated at 80-kw. output, were produced by the General Electric Co. during 1926. One was installed by the U. S. navy, at San Diego, Cal., one was shipped to the Japanese government for a station near Tokio; and one was built for installation by the Radio Corporation of America at Pernambuco. These three transmitters were of the same general design, being composed of a rectifier, master oscillator, and power amplifier units. They were designed for telegraph control at speeds up to 100 words per minute. By this method of control the output is varied from no load to full load or vice versa, 50 to 60 times per second. Water-cooled tubes were used throughout in the high-power circuits.

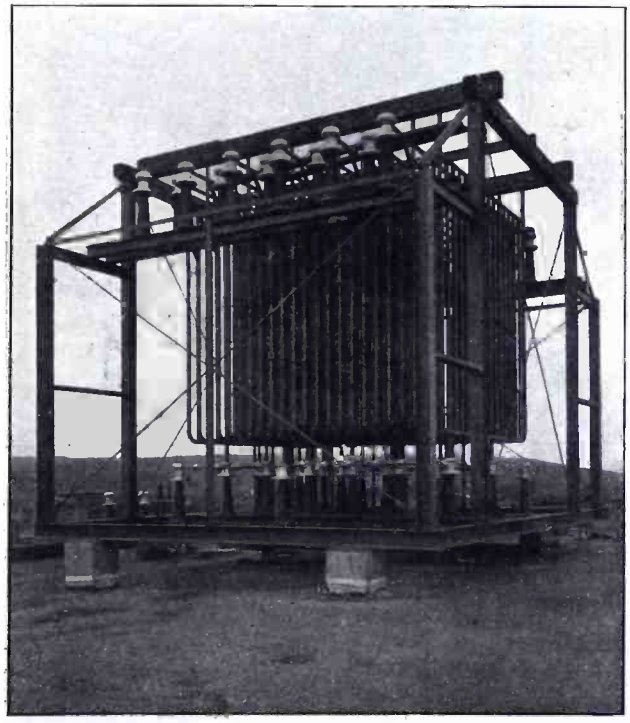
A new type of transmitter was developed and four were supplied to the United Fruit Company. They are rated at 5-kw. output, and are intended for shore installation to communicate with ships at sea. They operate at 600 meters and longer wavelengths, and do not cause objectionable interference with broadcasting.

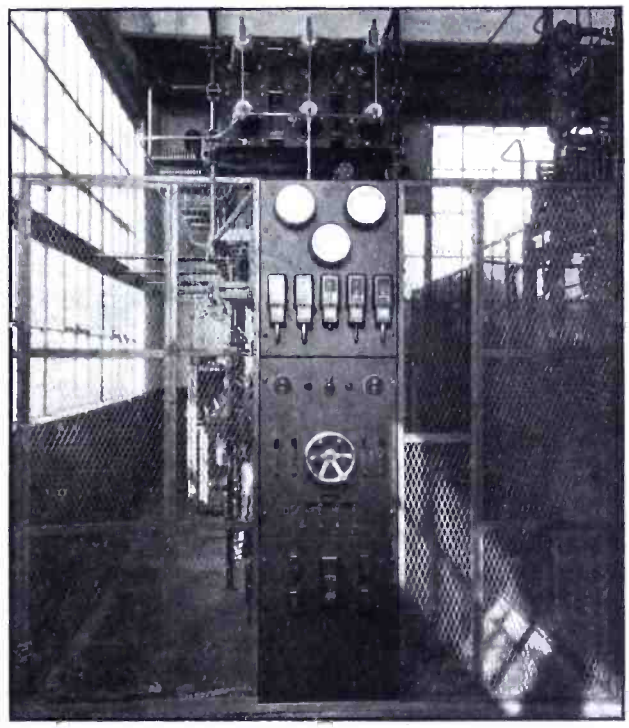
A number of 500-watt transmitters were built for the U. S. Coastguard for use on vessels on ice patrol duty and in other branches of the service. They cover a continuous wavelength range of 600 to 2,400 meters, with telegraph control.

The Department of Commerce adopted a number of 500-watt transmitters for use in sending fog signals to vessels during stormy weather. They emit a completely modulated signal, with the characteristic 1,000-cycle note, at a wavelength of approximately 1,000 meters. They have been installed at several points along the Atlantic and Pacific Coasts and in Alaska and enable ships to determine their bearings by means of a radio compass.

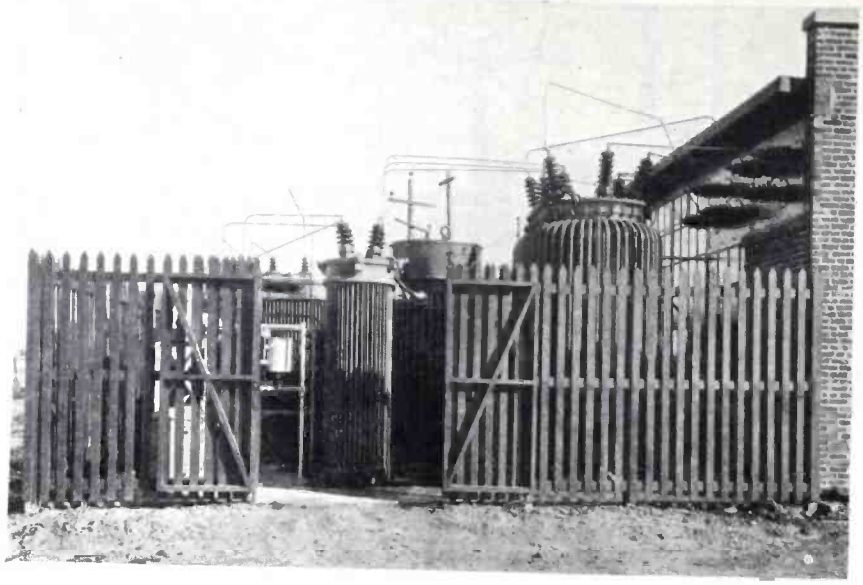
In order to make a complete test of high-power radio transmitters before shipments, there must be available a capacitor which has approximately the same electrical characteristics as the antenna with which the transmitter is to be used.

*General Electric Co.





The photograph at the left shows the Dummy Antenna Capacitor, which is used for testing high power radio transmitters. This capacitor can be so adjusted as to have approximately the same electrical characteristics as the antenna with which the transmitter is to be used. At the right is shown the control panel and tube-rack for a 750-k. w., 15,000 volt rectifier



At the right is shown the outdoor transformer equipment for a 750-k. w. rectifier. Below and to the left is a photograph of the power amplifier end of a 5-k. w. Marine Transmitter. Below and at the right is a high voltage rectifier, which uses six UV-214 Rectrons. The output is 10 amperes at 6,000 to 15,000 volts

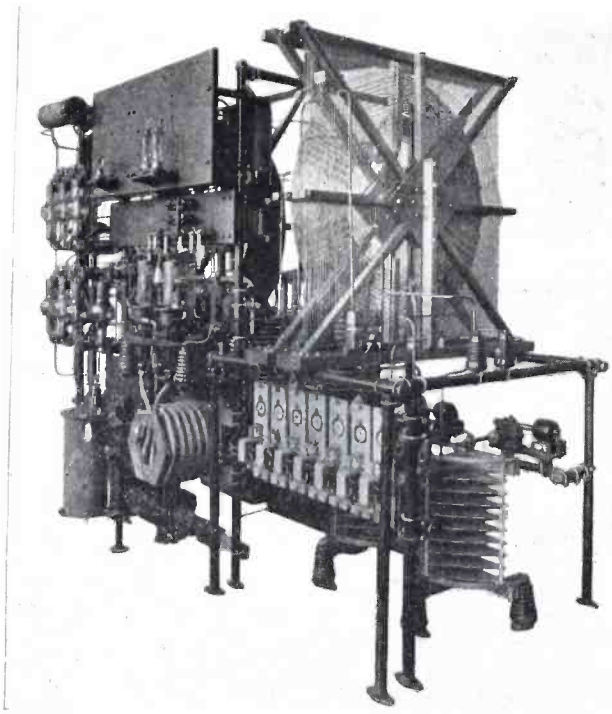
Such a capacitor was erected on the building in Schenectady in which transmitters are manufactured and tested. It is composed of 23 plates which are built up of parallel lengths of 3-in. diameter pipes welded into a square frame of pipes of the same diameter. Eleven of these plates are insulated from ground, for more than 100,000 volts, the remainder being insulated from ground for a lower voltage. The insulation between plates is rated at 100,000 volts. By means of different groupings of the plates, it is possible to obtain a wide range of values of capacitance up to the maximum of approximately 0.02 mf. The dimensions are approximately 24 by 25 by 33 ft.

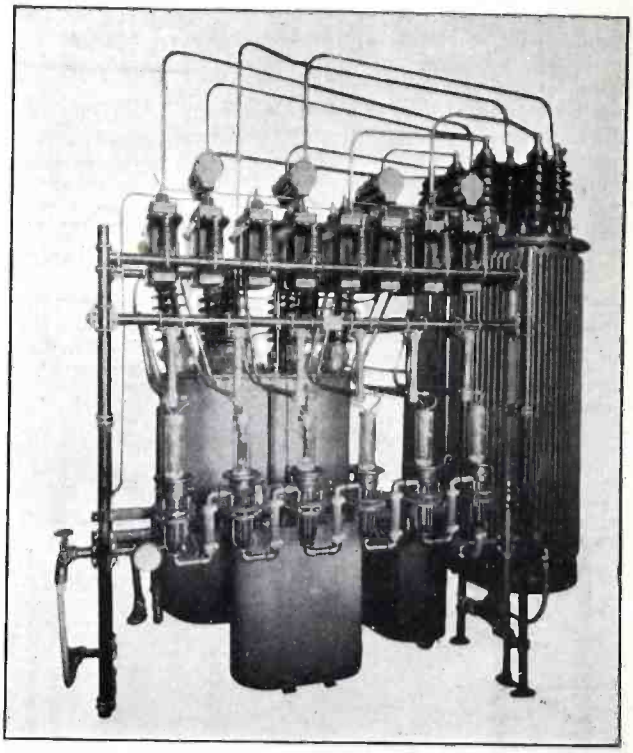
A spray insulator was constructed for insulating the anodes of high-power water-cooled vacuum tubes from the supply of cooling water. The insulation is accomplished by making both the inlet and outlet water connections to the tube in the form of tall glass vessels in which the stream of water is broken up into small drops with air spaces between. This arrangement gives practically infinite insulation resistance with resultant elimination of loss of power.

Continuous progress in the development of radio transmitters, particularly those for operation at high power and short wavelengths, necessitated obtaining new insulating material with low dielectric losses. The new laboratory product, "Mycalex," proved to be particularly suitable to those conditions and its use soon became general in the construction of transmitters.

Several branches of radio development were thoroughly investigated. The 50-kw. 380-meter transmitter was put in regular operation for the evening programs of WGY early in the year. Although still in the developmental stage, it has since been used regularly and successfully.

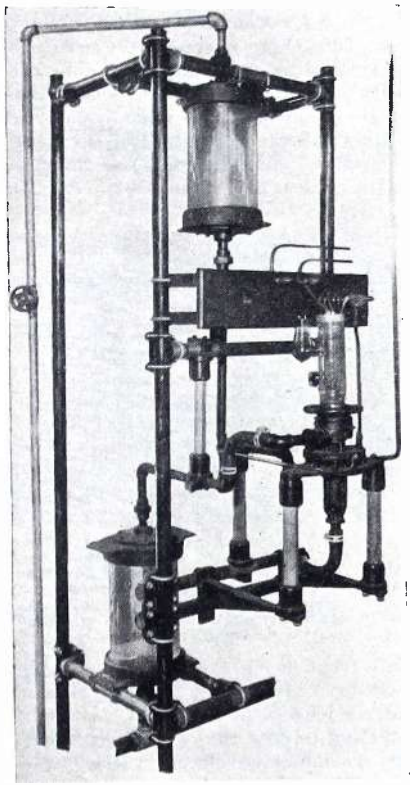
Extensive tests were made with the type of transmission known as "Single Side Band" which has several apparent advantages for broadcasting and communication purposes. Some of the anticipated improvements were secured by these tests. The transmitter was operated at a wavelength of approximately 1,500 meters





which does not interfere with broadcasting. Powers up to 40-kw. were used.

Observation on special transmission over a wide range of wavelengths resulted in a useful data on the propagation of radio waves. One of the most interesting features brought out by the study of these data was the ability of low-power short-wave transmitters to span enormous distances. In this connection, the performance of station 2XAF on 32.79 meters was notable, as this transmitter, operating at 10-kw. output, was heard repeatedly in Perth, Australia; in Johannesburg, South Africa; at Kings Bay, Spitzbergen, by members of the Byrd Arctic Expedition; and in the heart of Brazil by the Frank Gow Smith Exploring party.



A high power, water cooled vacuum-tube mounting, using a spray resistor

One of the largest and highest power high-voltage kenotron rectifier equipments in the world was installed at this station. It differs considerably from conventional designs. The tube mounting and control panels are located indoors, and the transformers and reactors are installed outdoors.

The initial tube equipment consists of 12 water-cooled kenotrons which will permit the rectification of 30 amp. Eventually, it is planned to replace these 12 tubes with six of much higher rating which will permit the rectification of 50 to 60 amp. A range of voltage of 6,000 to 16,000 is provided. On this basis the available output will be 900 kw. A filter reduces the output ripple to about 0.025 per cent.

Amplifier Ins and Outs

*Instructive data based upon laboratory experiments in amplification—By C. T. Burke **

ALL that goes up must come down," is a familiar axiom. If we could establish for radio a parallel axiom, "All that goes in must come out," the radio millennium would be reached. Designers are steadily approaching this goal, and the progress of the last few years has been enormous. During the last year particularly has the swing been toward getting out more of what went in, rather than getting more in. That is, the fad for "getting" stations is passing. In its place is arising a demand for natural reproduction. This is a problem of getting out all that went in, for if some notes are subdued or lost, in passage through the set, the reproduced music will not sound natural. This newly critical attitude refuses to regard radio as a marvel, to be accepted in silent wonder in spite of any shortcomings. The radio set is forced to stand comparison with other forms of entertainment on its merits as a musical instrument. This attitude is the compelling force behind the recent great improvements in audio amplifying and reproducing devices.

The problem of "quality," by which is meant the accurate and faithful reproduction of the matter sent into the air at the broadcasting station, is three-fold, embracing tubes, transformers, and loudspeakers. As each phase of the subject is worthy of individual consideration, only the second, that of transformers, will be considered here. The other two should not be forgotten, however, for the amplifier cannot be much better than its poorest element. Perfect transformers will not compensate for improperly biased, overloaded tubes or a squawky loudspeaker.

As it is not possible to invite all my readers into the laboratory to hear the tests I am about to describe, it is necessary to devise a means of putting the result on paper, so that they can use their eyes to judge instead of their ears. The means of doing this is to reproduce the "amplification curve." The data for this curve is obtained by measuring the amplification at a number of frequencies. A curve is plotted of amplification against frequency, and as the principal source of transformer distortion is unequal amplification of different frequencies, a study of this curve shows even more definitely than the ear could, just what is the relative rating of two amplifiers. It is not necessary to have the curve a straight horizontal line, which would indicate the perfect amplifier. A variation of twenty-five percent would not be perceptive to the average ear. The frequencies above five thousand may be lost without serious loss of quality. The curve should remain high for frequencies at least as low as one hundred cycles. Probably the most interesting part of the curve is that between one hundred and five hundred

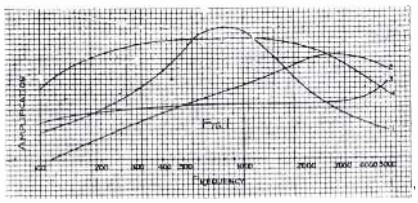


Fig. 1. A group of representative transformers. The superiority of the new types (curves 3 and 4) is marked.

cycles. Most of the older transformers failed to amplify in this range, and its full amplification is essential to natural sounding music. In order to study this part of the curve, which is crowded at the lower end, more easily, a special method of plotting the curves has been resorted to. Instead of making the distance along the frequency scale proportional to frequency, it has been made proportional to the logarithm of the frequency. The effect is similar to that obtained with the "straight line frequency" condensers now so popular. The lower end of the curve is opened up, spread over more space.

Just how much transformers have improved during the last few years is apparent from the curves of figure

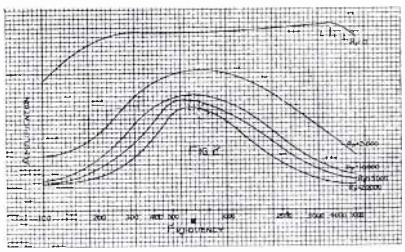


Fig. 2. The result of varying plate impedance on a transformer of low primary impedance. When the plate impedance equals that of the ordinary receiving tube (12,000-15,000 ohms) the curve is badly peaked

1, which show the characteristics of four transformers of different vintages. Transformers No. 1 and 2 are of the older types designed before the period of development of quality reproduction. No.'s 3 and 4 are both "new era" transformers. The difference between the new and the old is very noticeable. No. 1 has a marked peak at about eight hundred cycles. This frequency would be amplified to a much greater extent

* Engineering Dept., General Radio Co.

than those above and below, resulting in bad distortion. No. 2 lets through practically nothing under one hundred cycles and has but half its maximum amplification at four hundred cycles. Many frequencies that go into this amplifier do not come out. The result of this type of distortion, the loss of the low frequencies, is to give music a harsh mechanical sound. The transformers of curves 3 and 4 are a vast improvement over these earlier types, and are typical of several transformers making their appearance during the past year. The deviation of the maximum and minimum from the average amplification over this range is so slight as to be barely noticeable to the ordinary ear.

An interesting and important fact is discovered when the turns ratio of these four transformers is considered. No. 1 had 8.5:1, No. 2, 3:1, No. 3, 2:1, No. 4, 6:1. Note that the 8.5:1 transformer has a lower amplification than the 6:1 over practically the entire frequency range, and at both ends passes below even the 2:1. Another interesting point is that the 3:1 transformer distorts to a much greater extent than the 6:1, despite the popular idea that low ratio transformers necessarily have better characteristics than those of high ratio.

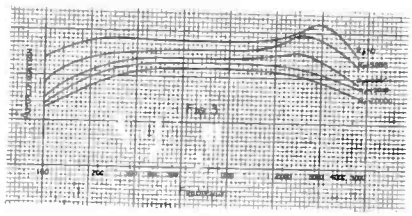


Fig. 3. The effect of plate impedance on the operation of a transformer of high primary impedance. The curves of Fig. 2 and 4 show the importance of making measurements with a resistance in series with the transformer primary. Otherwise an entirely false impression may be conveyed.

It was not entirely without reason that high ratio transformers have been viewed with some suspicion. Notice again the curve of the 8:1 transformer. This is typical of the older style high ratio transformers. The loss of the high frequencies is easy to understand. The coil capacity acts as a bypass for these frequencies, short-circuiting them to ground. The loss of the low notes is due to the fact that the primary turns were kept low in order to get high turns ratio with a small coil. The result of this practice may be explained with the assistance of the curves of Figs. 2 and 3.

In the audio amplifier, the transformer primary is connected in series with the plate impedance of the tube, which is about 15,000 ohms for the common types of receiving tubes. A considerable portion of the voltage supplied by the signal is used up in this impedance. The portion of the voltage left across the transformer primary depends upon the relation of transformer impedance to the total impedance of transformer and tube. Thus if the tube impedance is 15,000 ohms and the transformer impedance 30,000, two-thirds of the voltage will be impressed across the transformer primary. It will now be seen why a high ratio transformer sometimes gives less amplification than one of low ratio. Suppose a 5:1 transformer had 150,000 ohms impedance at a certain frequency. Another transformer with an 8:1 ratio has but 15,000 ohms impedance in the primary. Both are used with a 15,000 ohm tube, with 10 volts available. The 5:1 transformer will have 150,000/165,000 of 10 volts or 9.3 volts across the primary. Assuming no losses the secondary voltage would be 47 volts. Only 15,000/30,000 or 5 volts will be impressed across the primary of the 8:1 transformer, with a secondary voltage of 40.

As the transformer impedance varies with frequency, while the tube impedance remains constant, the input to the transformer varies over the frequency range. This of course results in distortion (unequal output of different frequencies). Distortion due to this cause can be reduced by means of a high primary impedance. The input to the transformer cannot be greater at any frequency than the tube voltage. If at the lowest frequency it is intended to amplify, the transformer impedance is three times the tube impedance, the input will not be less at any frequency than 75 per cent the tube voltage, that is, not more than 25 per cent difference in amplification of different frequencies can occur. On the other hand, if the transformer has but half the tube impedance at this frequency, the difference will be 65 per cent.

The curves of figure 2 were taken on transformer No. 1, using different values of plate resistance. If the plate resistance could be reduced to zero, even this transformer would give little distortion. The curve becomes more and more peaked as the value of Rp is increased, and the amplification per stage is greatly lessened. In figure 3 is shown a similar group of curves for transformer No. 4. This is a transformer of high primary impedance, 155,000 ohms at 1000 cycles as compared to 15,000 for No. 1. It will be seen that while the curve is better for the lower plate resistances, the difference is much less marked than in the case of No. 1. The advantage of a tube of low plate impedance is obvious. That is one of the advantages of the new R. C. A. tubes.

We have shown the essential requirement of equal amplification of all frequencies to be a high and nearly equal impedance at all frequencies. This is accomplished by the use of many turns of wire, with a large core of high permeability steel, and by proper coil design, avoiding capacity that acts as a bypass for high frequency. This requirement may be met in a transformer of high ratio as well as one of low.

So far we have been dealing with the problem of the manufacturers. They have met it with surprising success as several of the new transformers show. It is up to the builder to make the best use of the manufacturers' efforts and not spoil the result by touches of his own.

Many radio builders think it an advantage to shunt their transformers with condensers or grid leaks. While this practice sometimes helped to improve quality with the old type transformer, with a transformer of good design it generally ruins quality.

A condenser across the primary of the first audio transformer is usually advisable, and may be as large as 0.005 microfarads without affecting the faithfulness of reproduction. Devices across the secondary are particularly harmful. Fig. 4 shows the effect of several sizes of condensers and grid leaks across the secondary. The effect of the condensers on transformer No. 1 shown in the upper half of the figure is to make still more marked the peak in the central portion of the curve. The high frequencies are cut off with increasing effectiveness as the size of the condensers is increased. It is interesting to note that at some frequencies resonance effects carry the curves with shunting condensers above the normal curve. The use of grid leaks improves the quality with this poor transformer. With a leak of 1.5 megohms, a curve similar to No. 2 of figure 1 is obtained. This curve is poor but somewhat better than the normal one. When the shunting resistance is reduced to 200,000 ohms a very flat curve is obtained, but the 8:1 transformer gives less amplification than a 2:1.

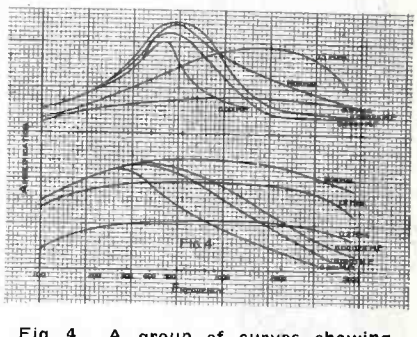
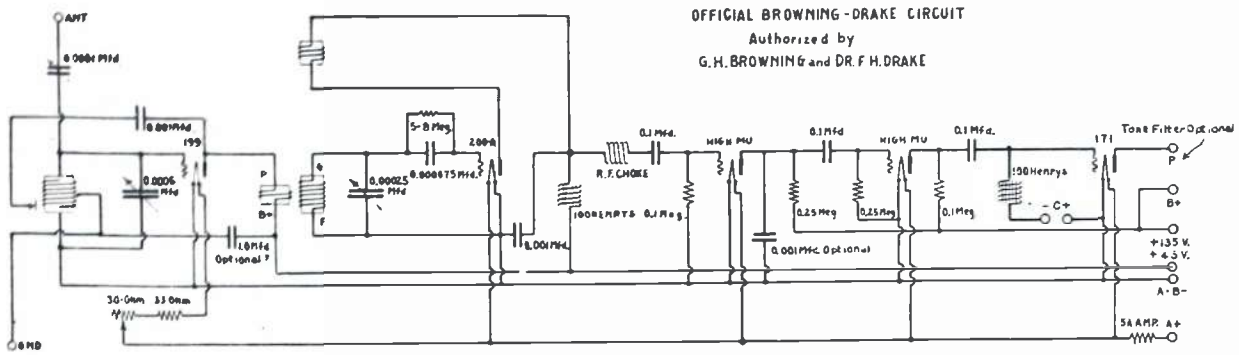


Fig. 4. A group of curves showing the effect of shunting various devices across the transformer secondary. The upper group were taken with a poor transformer, the lower on the newer types.

The effect of shunting condensers across the secondary of transformer No. 4 is similar to that observed in No. 1. The amplification of high frequencies is greatly reduced, with the point at which the curve falls coming farther toward the low frequencies as the condenser size is increased. The improvement in quality gained by shunting the secondary with a resistance is not so marked as with the badly peaked transformer. A great loss of volume is caused by this practice. With the 200,000 ohm resistance across the secondary the amplification is cut approximately in half, with no great inmprovement in quality that could be discerned by the average listener.



Schematic of the Authorized B-D Design. Circuit changes and mechanical refinements have greatly improved the operation of this popular receiver

Authorized B-D Design

Glenn Browning announces official circuit and layout which settles argument over Browning-Drake designs

THE Browning-Drake undoubtedly is one of the most popular circuits ever presented. This popularity has been justly earned for, properly constructed of the correct parts, this little receiver performs in a thoroughly capable manner, and delivers results which would do credit to more expensive sets.

Due to this popularity of the Browning-Drake circuit, it is only natural that it has been presented in many different layouts, incorporating several types of audio amplifiers. We will not discuss here the merits of the respective designs, for such a discussion is not vitally related to the matter at hand.

However, it can be said here that this presentation of so many different designs has been detrimental, in a way, for it has caused great confusion in the minds of many prospective set builders. Particulary is it unfortunate that some layouts have been described as improved Browning-Drake receivers. As a matter of fact, no real improvement was made in any of these, for the standard Browning-Drake circuit was used in every case, although various audio amplifiers were applied to it.

To obviate further confusion, and to establish once for all a reliable layout, G. H. Browning has brought forth a new design*, which bears the stamp of his approval and is henceforth to be considered as the authoritative layout. The adjective "improved" might be well and truthfully applied to this set, for it incorporates both electrical and mechanical refinements. It is shown here for the first time.

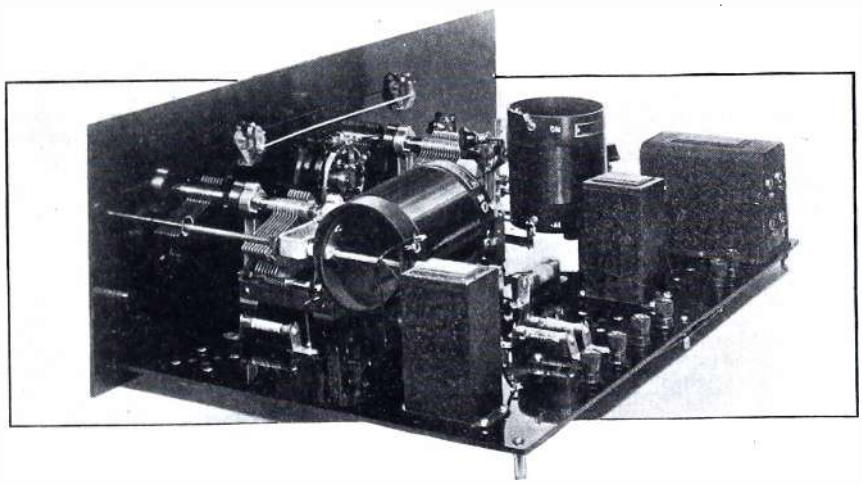
Mechanically, radical changes have been made in the construction of the Browning-Drake kit, particularly in the National condensers used. The new ones are fitted with a new type frame, and the main shaft of the rotor plates is hollow. This feature permits the use of a tuning shaft of any desired length or material. For instance, an insulated shaft can be inserted when it is desired to use the condenser in a circuit where both sides are above ground potential. More about this feature, and its application to the new circuit, will appear later in this article. The number of turns on the antenna coil has been changed also, on account of the modifications in the R. F. end.

The rotor plates of the previous models of National condensers, used in conjunction with the coils for the Browning-Drake circuit, swung over an arc of 270 degrees. In the new models, this swing is confined to 180 degrees as in the conventional type. Although the dial space afforded a given station is less than with the older models, the straight frequency line construction avoids dial crowding.

Electrically, a number of changes have been made in the circuit itself. First, a different method of neutralization is employed on the R. F. tube, which is of the 199 type, as before. Reference to the schematic will enable the reader to picture more clearly how this is accomplished. A .001 mfd. fixed condenser is placed in series with the plate of the R. F. tube and a small brass disk which is about the size of a quarter. This disk is so mounted on a threaded rod that its relationship to the low potential end of the antenna coil can be varied. In this manner, neutralization is readily accomplished, and this method is less dependent upon frequency than the one formerly used. An insulated shaft is used on the antenna tuning condenser, for both sides of the circuit are above ground potential.

In the former Browning-Drake, the antenna was conductively coupled to the grid of the R. F. tube, by means of a tapped antenna coil. In the new model, the antenna is capacitatively coupled to the grid through a midget variable condenser, of .0001 mfd. maximum capacity. By the use of this method, any desired degree of coupling can be obtained easily, and the variations introduced in the circuit by antennas of various lengths can be compensated for. Further, any desired degree of selectivity can be acquired by the variation of this condenser.

The use of the 1. mfd. condenser,



A view of the new Official Browning-Drake receiver, after assembly. Truly a ship-shape layout, for symmetry and short leads are preserved with no sacrifice of efficiency

*Complete construction article in Radio MECHANICS for March.

which bypasses the 45 volt lead to the R. F. tube, is optional. However, it is recommended that this condenser be inserted as shown, for it promotes the stability of the R. F. end of the receiver. The R. F. tube and detector operate from the same voltage, and a potential of about 45 volts is recommended at this point. It is inadvisable to use 90 volts on the R. F. stage, for this tube operates without a negative bias, and the life of a 199 type tube would be very short under such conditions.

The detector circuit is the same with the exception that the CX 300 A detector tube is recommended. The audio amplifier, however, is different from that employed in any of the designs heretofore presented. This particular arrangement has been very carefully worked out, and the theories behind the methods used have been well substantiated by very gratifying results in actual practice. It was the aim of the designers to combine a high quality of amplification with a freedom from "steamboating" when the set was to be used with a B eliminator.

The first stage of audio is impedance coupled, in a conventional manner. The impedance used here contains an R. F. choke, and this, in combination with the .001 mfd. condenser from detector plate to filament, keeps stray R. F. currents out of the audio amplifier. The use of an impedance here is a decided advantage, for but little drop in voltage is lost through it, and a consequent greater gain from the detector is realized. Further, an impedance stage following the detector has but little tendency to cause "motorboating."

The second stage of audio is resistance coupled. Here again a .001 mfd. bypass condenser is used from plate to filament, and bypasses any R. F. which might get by the R. F. choke.

The third audio stage is coupled differently from either of the first two. A standard impedance is used, but the connections have been reversed. The resistor is used in the plate circuit of the preceding tube, instead of as a grid leak, as is customary. The impedance is then used as a grid leak, and the C bias for the power tube is applied through it.

This arrangement has many advantages over the conventional method. There is much less tendency to "steamboat" than when straight resistance coupling is used in the last stage. Further, it will be found that there is no longer present any tendency to block on strong signals. Since resistances are in the plate circuits of the preceding tubes, the full 180 volts applied to the 171 power tube can also be put on the first and second stages.

The filaments are all controlled by a ballast resistance, which is in series with the A+ lead. In addition, a fixed resistance and a rheostat are in series with the filament of the 199. With this system employed, overloading of the 199 filament is prevented, and the rheostat serves as a very effective volume control.

The receiver is designed to use a 199 tube in the R. F. socket, a 200-A special detector, 201-As or high-mus in the first two audio stages, and a 171 in the output stage. In order to protect the speaker against damage by the large plate current of the 171, a tone filter is connected in the output. This consists of a choke coil of high inductance, and a condenser of 4 mfd. capacity. With this arrangement, all of the D. C. is kept out of the speaker windings, and only the A. C. component of the plate current actuates the unit.

The authorized B-D design is an excellent example of sound engineering principles correctly applied. The performance of the new outfit is even better than that of its predecessor, and is such as to satisfy the most critical. It is to be hoped that this establishing of a standard design and layout will help to obviate much of the existing confusion about the receiver.

The list of parts, as specified for the authorized B-D design, is as follows:

1 set Browning-Drake coils and condensers.
1 Foundation Unit, consisting essentially of front and base panels drilled and engraved, with sockets, resistor clips, and soldering lugs (Browning-Drake Corp.).
1 National Impedaformer (1st stage).
1 National Impedaformer (3rd stage only).
1 .1 Tobe condenser, special type.
3 .001 Tinytobe fixed condensers.
1 .00007 Tinytobe fixed grid condenser.
1 Yaxley filament switch.
1 Yaxley 30 ohm rheostat.
8 Eby binding posts (Ant., Gnd., A+, (A—B—) B+Det., B+Amp., C+, C–).
1 Precise Midget .0001 variable condenser.
1 Browning-Drake 33 ohm resistance cartridge.
3 resistances (one .1 meg., ¼ meg., one 8. meg.) (Electrad).
1 Browning-Drake balancing or neutralizing device.
1 Amperite, type 5-A.
2 Yaxley pup jacks (If tone filter is not used).
1 National tone filter (optional).
1 1 Mfd. Tobe condenser (optional).

Quality Amplification and Constant B C Supply

Presenting some new features as applied to power amplifier and current supply devices—By J. E. Coombes

THE power amplifier is enjoying a justly earned popularity, because of the great improvement in volume and quality of tone which inevitably follows the use of this device. The dealers and service men who are right on their toes, and who are quick to take advantage of every opportunity, have been cashing in on this fact.

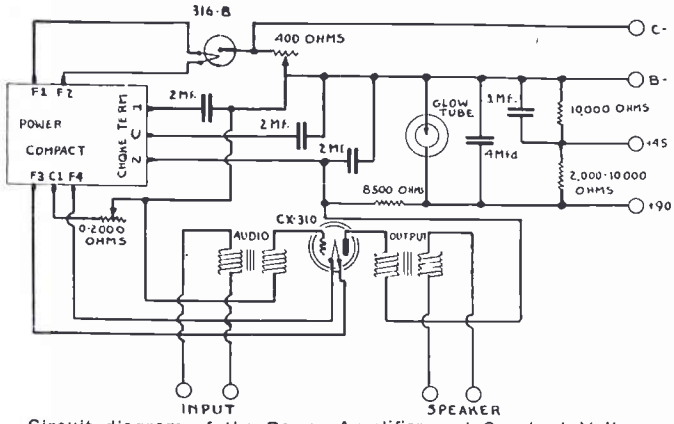
A short time ago, but little was known of B eliminators and power amplifiers, and some of the dealers and their technical men were afraid to explore this new field. Needless to say, the more venturesome ones started investigating this new opportunity at once, and were more than amply rewarded for their efforts.

At first the parts necessary to construct a device of this kind were bulky, cumbersome, and difficult to wire. Now, however, the advent of greatly improved and simplified apparatus has eradicated this fault, and the assembly of these outfits requires but a short time.

Presented here is a brand new design of a 310 power amplifier, which incorporates every feature to be desired of such apparatus, and which embodies all of the latest improvements. The assembly is built around the new Thordarson Power Compact, which contains, in one case, the power transformer and two chokes. This unit greatly simplifies the assembly of the apparatus, for all the terminals are brought out to convenient posts on the case.

The 316-B tube is used as the rectifier, for this tube is necessary when sufficiently high voltages are desired for the best operation of the 310 tube. In addition, a 374 Glow tube is used here, and is so wired into the circuit that it holds constant the 45 and 90 volt taps which supply these voltages to the receiver. For this reason, it is neither necessary nor desirable to use variable resistances for regulating the output.

A variable resistance is used for regulating the C bias to the power tube, however. A fixed resistance in this position will give quite satisfactory operation, but the variable resistance permits the bias to be adjusted so as to get the very best tone quality from the system. To further facilitate this adjustment, a milliammeter is mounted on the front panel, and indicates the amount of B current drawn from the outfit. In addition, the milliammeter gives a very effective check on the operation of the device, for distortion caused by overloading will be indicated by erratic behavior of the needle.



Circuit diagram of the Power Amplifier and Constant Voltage Eliminator. The Glow tube automatically compensates for variations in line and load

A low resistance potentiometer is inserted in the B minus lead, so that the entire current from the rectifier must flow through it. Reference to the schematic will enable the reader to form a more clear impression of how this is done. Now, as the potentiometer is varied, there will be a difference in potential between the two terminals used, and the voltage so developed can be used conveniently for biasing purposes. That is what has been done here, and a source of C potential is available for the receiver.

The resistance for obtaining this C voltage is bypassed with a 1. mfd. condenser, for otherwise the receiver might howl, due to the presence of resistance coupled feedback. A 4. mfd. condenser is shunted across the glow tube, and the presence of this high capacity effectually stabilizes the entire eliminator part of the outfit. In addition, a 1. mfd. condenser is used to bypass the fixed resistance in the 45 volt lead.

The filament supply for the 310 power tube provides a center tap for the grid return. This tap is located in the exact electrical center by a unique method. Two equal coils are wound side by side on the same core, and the center tap is taken from the junction of the two coils. It is a decided tribute to the efficacy of this arrangement that not a trace of hum can be heard from the completed assembly.

For ordinary purposes, and when the eliminator and power amplifier is used on sets which draw a low current from the 45 volt tap, the resistance which is connected from the 90 volt to the 45 volt post should be about 10,000 ohms. However, many multi-tube sets, particularly super-heterodynes, require 45 volts for a number of tubes. In this case, this resistance should be replaced by one of a lower value, depending upon the milliamperes drawn from the 45 volt tap. After the correct value has once been found, this resistance will not have to be changed again.

As presented here, the operation of the outfit is practically fool-proof. In those designs which use variable resistances for controlling the intermediate voltages, it is necessary to caution the user against promiscuous turning of the voltage controls, for otherwise several hundred volts might be applied to the tubes in the receiver, with disastrous results. No such precautions need be observed here, for nothing is variable except the bias controls, and a change in the setting of these is at once accompanied by a very evident loss of tone quality.

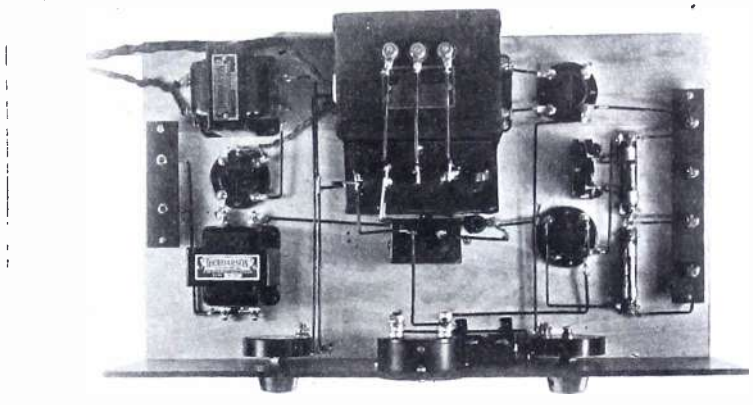
It is generally believed that the 310 tube is far superior to any other, as a power amplifier. It is true that the 371 type has ample handling capacity, but its use is generally accompanied by a decrease in volume, unless it is attached to a very powerful and sensitive receiver. However, the 310 affords maximum handling capacity, and is capable of reproducing an entire orchestra at full volume. The high grid, plate, and filament voltages required by this tube are no longer a disadvantage, when apparatus of the type shown here is used.

The dealer needs to waste no time on sales talk with a power amplifier. It is merely necessary to demonstrate a receiver without the quality amplifier, and then switch this device on to the same set. The difference in volume and quality of tone is so apparent at once that the prospect is immediately sold on its merits.

However, the dealer should strive to eradicate one impression that seems to linger in the mind of the layman. That is, that a power amplifier is primarily a device for producing great volume, and entertaining an auditorium full of people. While it is true that a power amplifier is capable of doing these things, it is really intended to furnish the best possible tone quality.

The list of parts, as used in the power amplifier and BC supply described here, is as follows:*

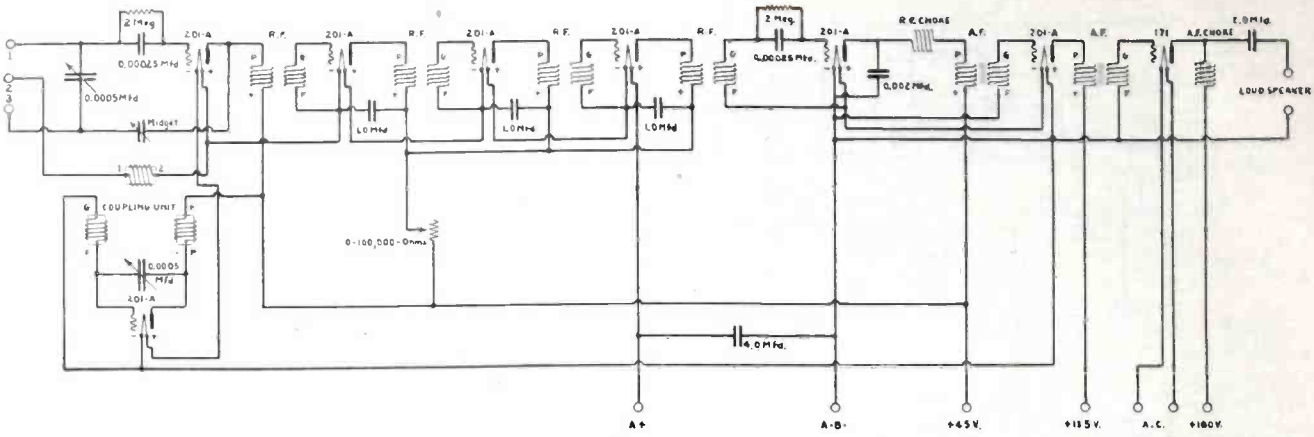
1 Thordarson Power Compact, type R-210;
1 Thordarson Audio Transformer, type R-200;
1 Thordarson Speaker Coupling Transformer, type R-76;
1 Muter High Voltage Condenser Block, tapped at 0, 2., 2., 1., 1., .1, and .1 mfds.;
1 Muter 4. mfd. Condenser, working voltage 160 DC;
2 Muter 1. mfd. bypass condensers;
1 Centralab Heavy Duty Potentiometer, 2,000 ohms;
1 Centralab Potentiometer, 400 ohms;
1 Weston Milliammeter, 0-50 Milliamperes;
3 Silver Marshall No. 511 Tube Sockets;
2 Amsco Resistors, 10,000 ohms;
1 Amco Resistor, 2,000 ohms;
3 Resistor Mounts;
1 Ward-Leonard Vitrohm Resistor, 5,000 oms, No. 507-2;
1 Ward-Leonard Vitrohm Resistor, 3,500 ohms, No. 507-28;
2 Carter Tip Jacks;
1 Loud Speaker Cord;
4 Eby Binding Posts: 90 volts+, 45 volts+, B—, and C—;



Airplane view of the assembled Eliminator and Power Amplifier. Simplicity of layout, wiring and assembly are noteworthy features

4 Brass Pillars, 5/16 in. diameter by ¾ in. long, drilled and tapped for 6/32 screws;
1 Hard Rubber Binding Post Strip, 1 in. by 7 in.;
1 Hard Rubber Strip, 1 in. by 4 in.;
1 Bakelite or Hard Rubber Front Panel, 7 in. by 18 in.

* Complete construction article in RADIO MECHANICS for March.



Circuit diagram of the Victoreen Socket-Power Super. Note that the grid return of the power tube is made directly to—A. Bias for this tube is provided for in the O1-ABC Eliminator[1]

The Victoreen Socket-Power Super-Heterodyne

Full AC operation and single control combined in this amazing receiver—By Hollis De Neefe

THE Victoreen Socket-Power Super described here leaves nothing whatever to be desired in the way of an outfit that can satisfy any and all requirements, regardless of how difficult they may appear to be. Any representative group of people, questioned as to the features they would like to have in their own set, undoubtedly would enumerate the exact points that are incorporated in this receiver.

This Victoreen Socket-Power Super* is the result of intensive investigation and research in our laboratory at Radio Hill. We were not content to make merely one or two improvements in the conventional design of this outfit. We decided to eradicate, at one bold stroke, all the difficulties of care and operation ordinarily connected with radio receivers. We wanted to make a set that any child could operate, that any woman could enjoy, and one that would command, by sheer merit of performance, the respect of everyone.

It is easily understood that all difficulties have been overcome, and all possible requirements satisfied, when the following facts are considered, and the attendant features of the receiver are noted.

First, the Victoreen Socket-Power Super operates without batteries of any kind. All of the necessary A, B, and C voltages, required by the 7 201-A tubes and the 171 power tube, are taken direct from the O1-ABC eliminator. There are no storage batteries to care for, no chargers to connect, and no B batteries to wear out and be replaced. One switch in the AC line controls the whole outfit.

Second, the tuning is done with one dial. For all local and moderately distant stations, this one control is sufficient. However, this is an extremely selective receiver, and if the oscillator and loop circuits were slightly out of resonance on certain wavebands, distant stations might be passed over, unnoticed. Therefore, to take care of this condition, an equalizing adjustment is provided on the master control unit, and this provides a means of keeping both circuits in exact resonance over the entire scale.

Third, a loop is the only pickup device employed. A loop provides plenty of input for this powerful and sensitive receiver, and, of course, it has many other advantages. The loop is very helpful in eliminating undesired interference and in selecting the station desired. A loop is a decided convenience for those sets which are sufficiently sensitive to operate on one satisfactorily, for it obviates unsightly outside antennas and a great deal of noise.

Fourth, the receiver is very compact, and can be installed in any convenient place. Since there are no connections to be changed or adjustments of accessories to be made after the set has once been put into operation, this feature is a decided advantage. This compactness of assembly was not achieved at a sacrifice of efficiency, however. In fact, the Dreadnaught design employed permits of very short leads, and a straight sequence of circuits.

Fifth, the side pieces, hinged to the top shelf of the assembly, form a very neat and serviceable cabinet. If it is desired to make some repairs or an inspection of the circuit, these side pieces can be raised, and all the apparatus in the interior is readily accessible.

We will not discuss here the qualities of distance reach, quality of tone, selectivity, and volume, in connection with this receiver. These attributes, combined with a lot of wild and extravagant statements, have been claimed for so many radio receivers and circuits that our claims for this particular set might be discounted. We will say, however, that the performance of the Victoreen Socket-Power Super, judged by any standards of test or comparison, will convince the most skeptical listener of its efficiency and ability.

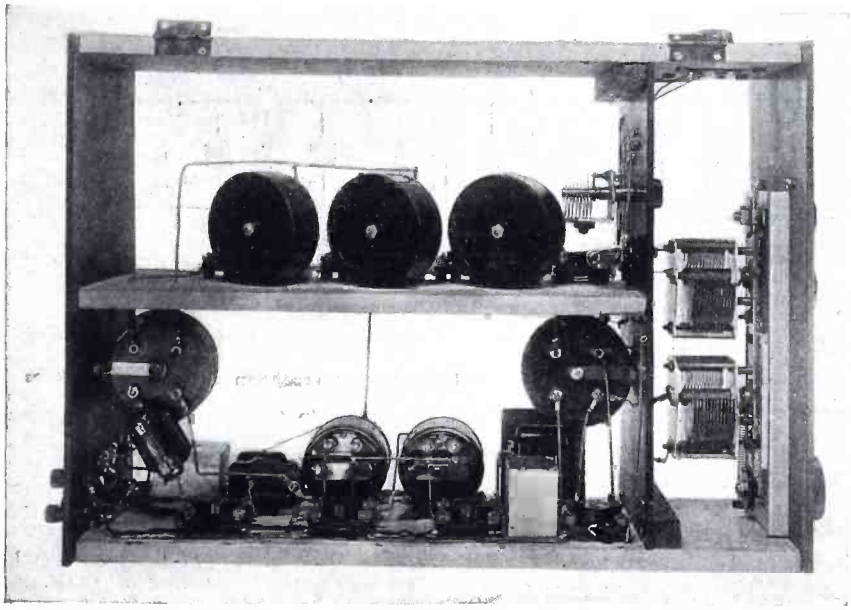
Reference to the schematic diagram discloses several interesting features in connection with this receiver. The filaments of the 201-As are wired in series, which procedure is necessary in order to adapt the circuit to the O1-ABC eliminator. The grid return of each intermediate transformer is made direct to the minus A of the tube into which it feeds. The intermediate amplifier is inherently stable with this arrangement, due to the transformers used. Obviously, one potentiometer could not be employed to regulate bias on all the tubes, since the filament of each is at a different potential. The stability of the intermediate stages is further enchanced by the liberal use of large condensers, which effectually bypass all stray R.F. directly back to the filaments.

A variable high resistance is inserted in the B plus lead which goes to the first detector and to the intermediate amplifiers. This is in no sense an oscillation control in this

* Complete Construction Article in Radio Mechanics for February.

[1] Complete construction article in RADIO MECHANICS for January.

particular circuit, because, as said before, the set is naturally stable when no potentiometer or other stabilizing device is employed. However, it is vitally important to provide a volume control on the outfit, for otherwise, the volume delivered by this powerful



Looking at the receiver from the left, the loop input is at the top. From loop input to loudspeaker output a straight sequence of circuits is maintained, with a consequent realization of maximum efficiency

receiver would be excessive, for normal home requirements. The variable high resistance effectively controls the intensity of the received signals, and cuts them down at a point where overloading of the second detector and audio amplifier is prevented.

The first audio tube has 135 volts of B applied to the plate. Therefore, this tube is biased 5 volts negative. This bias is obtained by the drop across the filament of the second detector. That is, the grid return of the first audio is made to the minus F of the second detector. The grid return of the power tube is made direct to A minus, for the high bias on this tube is taken care of in the 01-ABC circuit.

A 4 mfd. condenser is placed directly across the A plus and A minus terminals. It was not found absolutely necessary, during laboratory tests, to include this by-pass condenser, but its use is advisable in a series filaments circuit, because the various filaments are at different potentials. As an added precaution, it is suggested that the cases of the audio transformers be grounded to the minus A line, which is also grounded.

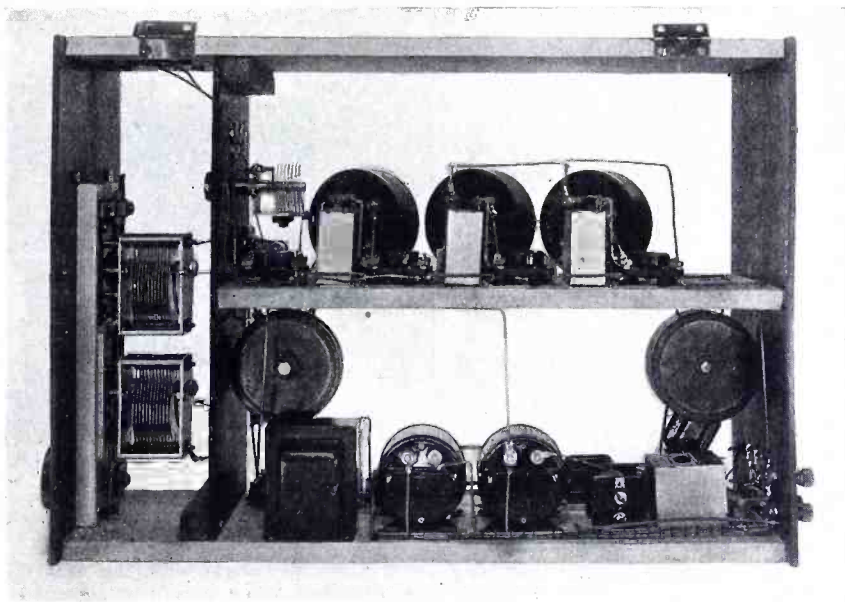
Any tendency of the audio amplifier to oscillate, or howl under strong signals, can be cured effectually by shunting a gridleak of about .2 megohm across the secondary of the first audio transformer. The use of this gridleak is recommended in any case, for the quality of reproduction will be improved and the audio end will be made more stable. Instead of a fixed leak, a variable high resistance of about 500,000 ohms maximum can be used for the same purpose. This control need not be placed on the panel, for it can be adjusted once for best reception, and it will never have to be touched again.

Regeneration is used in the first detector circuit, and is accomplished by a midget feed-back condenser. Regeneration sharpens the tuning and increases the distance range greatly. Further, it makes the loop more directional and overcomes the difficulties sometimes encountered when using a loop in a steel building. The feedback condenser is not mounted on the front panel, because it is possible to throw the first detector into oscillation if regeneration is pushed too far. Therefore, the midget condenser is located on the inner panel, and, after it is once set where the first detector will not oscillate over the entire waveband, it need not be adjusted again.

Assuredly, the Victoreen Socket-Power Super represents the highest type of receiver that can be built, with our present day knowledge and facilities. It is safe to say that this set approaches the ultimate in receiver design, and that further radical improvements will have to be made in accessories, and in broadcasting itself, before the operation and convenience of the set can be improved.

The complete list of parts, as used in the laboratory model of the Victoreen Socket-Power Super-heterodyne, is as follows:

1 Victoreen No. 150 coupling unit;
4 Victoreen No. 170 R.F. Transformers;
1 Victoreen Master Control Unit;
1 Bodine DeLuxe loop;
8 Benjamin spring mounted sockets;
2 Karas Harmonik Audio Transformers;
1 Thordarson choke coil, type R196;
1 Hammarlund 11 plate midget condenser;
1 Tobe 4 mfd. bypass condenser;
1 Tobe 2 mfd. filter condenser;
3 Tobe 1 mfd. bypass condensers;
2 Sangamo .0003 mfd. fixed condensers with gridleak clips;
1 Sangamo .0015 mfd. fixed condenser;
2 Gridleaks, 2 megohms, any good make;

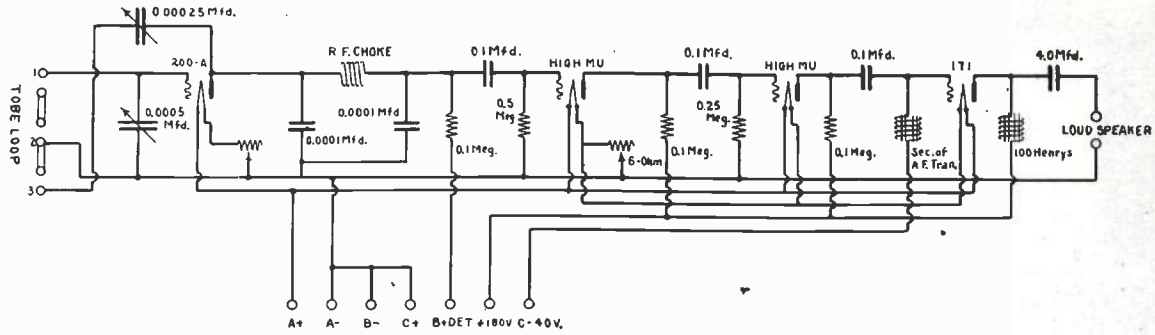


A right hand view of the assembled receiver. For the sake of clarity, the side pieces, which are hinged to the top so as to form the cabinet, have been removed

1 Kurz-Kasch Aristocrat Vernier port dial;
1 Kurz-Kasch standard rheostat knob;

1 Carter Hi-Ohm, 50,000 ohms;
5 Union phone tip jacks;
7 Eby binding posts, marked as follows:
2 plain, A plus, A minus, B plus 45, B plus 135, B plus 180;
1 Samson No. 85 R.F. Choke Coil;
35 feet Acme Celatsite wire, yellow insulation;
10 feet Acme flexible Celatsite wire, black insulation;
2 panels, Bakelite or Hard Rubber, 7 x 14;
1 panel, Bakelite or Hard Rubber, 6 x 13;

This receiver offers a splendid opportunity to the dealer for cashing in on some new and undeveloped parts business. The entire outfit is simplicity itself, and the dealer who builds the first one will gain himself an enviable reputation as an authority on AC operation.



Schematic of the four tube loop operated receiver, specifically designed for high quality reception from local stations

Use of Loops Increasing

Loop operated receivers provide quality reception despite broadcast congestion—By Maurice M. Osborne

POPULAR opinion favors the loop operated receiver over those using any other type of pickup medium. The reasons for this are not difficult to determine, when one considers the many advantages connected with the use of a loop. Aside from the fact that installation difficulties are obviated, a loop does not pick up so much extraneous noise,—that is, the signal to static ratio is better when a loop is employed.

During the last year the quality of programs being broadcast from the various large stations has greatly improved. The increase in tieups over a large area has made the very finest music and entertainment available all over the country from local stations. Not only are the standards of the music and entertainment extremely high, but the technical improvement in broadcasting itself has been so great, that providing proper radio receivers are used, programs may be received with such fidelity that it is practically impossible to distinguish them from the original. This is all the more true because reception of the broadcast from the local stations always means a minimum of background noises, static, etc.

The set* to be described has been under development for over a year. It began as a two-tube reflex with one stage of untuned R.F., one stage of audio and the regenerative detector. During its development, quality and selectivity were most sought for. The set in its final form has become a simple regenerative detector on a loop with a three-stage resistance-audio amplifier following it.

More will be said of the performance of the set later. It suffices here to say that it is capable of selectivity considerably in excess of many sets using one or more stages of tuned Radio-Frequency, that its quality, when used with a first-class loudspeaker is probably unexcelled by that of any set on the market, that its volume leaves nothing to be desired, and finally, that its construction and operation are extremely simple.

It is made primarily for the reception of local signals with the utmost quality, but when carefully adjusted and using a special detector tube, it is capable of thousand-mile loudspeaker reception under favorable conditions. An additional advantage is that it can be operated equally well on dry B-batteries or a B-eliminator.

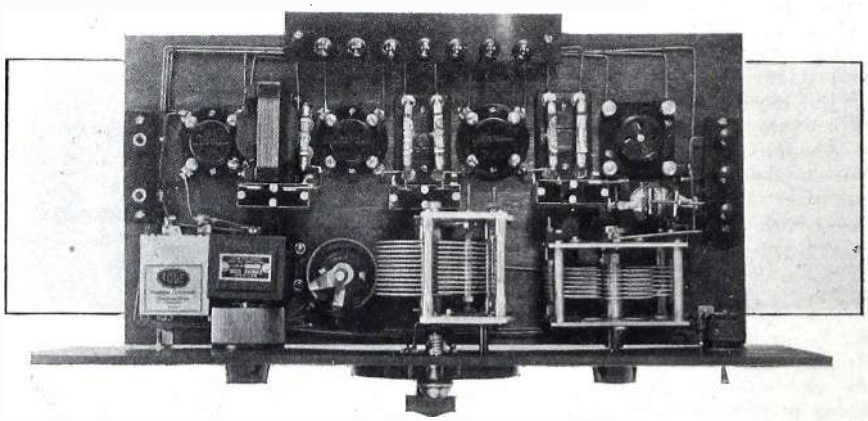
By referring to the schematic, it will be noticed that regeneration is obtained in the loop circuit by means of a feed-back condenser of .00025 mfd.

A negative bias is placed on the detector grid through the detector rheostat,—this being sufficient for satisfactory operation.

The detector output passes through an R. F. filter consisting of an R. F. choke, by-passed to ground on either end by a .0001 mfd. fixed condenser.

The audio amplifier consists of three stages of resistance coupling, using two high-mu tubes and a UX-171 for the power tube. In order to prevent blocking of the power-tube grid, for improvement of quality and prevention of motor-boating on certain types of B-eliminators, an impedance grid-leak, which is the secondary of the small audio transformer, is employed on the power tube. The power-tube output is through a 4 Mfd. condenser, so that all D. C. is kept out of the loud speaker windings for protection and further improvement of quality.

What we have is, therefore, a detector circuit which through regeneration reduces resistance of the loop used for pick-up to a very small value, thereby increasing its pickup and greatly sharpening the tuning. This is followed by an audio amplifier of



Bird's eye view of the loop receiver. The small audio transformer is used as an impedance grid leak in the last audio stage

* Complete construction article in March RADIO MECHANICS.

advanced design, which is independent of frequency, and the range of which is limited only by the quality of the station output and the ability of the speaker used to reproduce the highest and lowest notes.

The list of parts used in this design is as follows:

1—Tobe DTW loop
1—National "Equicycle" variable condenser .0005 mfd.
1—National "Equimeter" variable condenser .00025 mfd.
1—National Velvet-Vernier illuminated dial, Type C
1—General Radio 30-ohm rheostat, with knob, for panel mounting
1—General Radio 6-ohm rheostat without knob, to be mounted on baseboard
3—Tobe 0.1 mfd. filter condensers
1—Tobe output condenser, for power output, 4 mfd.
2—Tinytobe .0001 mfd. fixed condensers
3—Tobe vacuum "Tipon" leaks 0.1 meg.
2—Double grid-leak clips—any good make
1—Single grid-leak clip—any good make
1—.25 meg. Tobe vacuum Tipon leak
1—.5-meg. Tobe vacuum Tipon leak
1—Samson radio-frequency choke, No. 85
1—National Impedaformer, type A
1—Small audio transformer
4—UX sockets—Benjamin or General Radio
1—Filament switch
3—Eby binding posts and binding post strip, 3½ inches by 1 inch, for loop terminals
2—Tip-jacks and binding-post strip of hard rubber or Bakelite 2½ inches by 1 inch, for loud-speaker cord tips
7—Eby binding posts, marked as shown on picture wiring-diagram, and hard rubber or Bakelite binding post strip—7 inches by 1 inch
1—Hard rubber or Bakelite front panel—7 inches by 18 inches
1—Hardwood baseboard—9 x 17 inches x ½ inch thick
1—Baker Cabinet.

L-W Circuit for SW Sets

The Loftin-White system applied to the New Day Set adds greatly to the sensitivity—By Bert E. Smith*

WHEN the original description of this set was written for Radio Mechanics some months ago it seemed to include all the refinements which were possible in a receiver of this type, but since then one of the most promising developments of recent years in the science of Radio has been made available to the set builder.

We refer to the system of radio frequency amplification sponsored by Commander Edward Loftin. The principal advantage of this system is the tremendously better interstage coupling possible in tuned radio frequency sets, but its application to the three circuit tuner provides an increased sensitivity of as high as sixteen times.

Inductive coupling, as ordinarily used, must be sufficiently weak to allow selectivity on the lower edge of the band which the particular inductance-capacity combination covers. Capacitative coupling must be small to reach the lower end of the band, and hence is comparatively inefficient at the upper end. One method of compensating for this inefficiency is to provide a large primary provided with taps so that the coupling can be increased for the lower frequencies. The last popular adaption of this was in the Roberts circuit, and a great deal of this well known circuit's popularity was due to the fearlessness of Doctor Roberts in putting the obsolete tap switch on the panel.

The series antenna condenser was also designed to give the same result, but its inefficiency and impracticability have long since been thoroughly demonstrated.

Without going into a full technical explanation, the action of the Loftin-White system may be briefly described. It automatically, without any additional controls, adds capacitative coupling between the antenna and grid of the input circuit, while maintaining the inductive coupling necessary for operation at high frequencies. Its application to the New Day circuit is very simple. Connect the antenna to the end of the primary coil to the stator of the three plate condenser, and also to the rotor of the tuning condenser. The rotor of the tuning condenser must be removed from all other connections. Ground the "A" battery, and also the frame of the three plate condenser.

The operation of the set is the same as before, with one exception. The three plate condenser is used at maximum capacity for broadcast reception as well as for wavelengths above one hundred meters. In order to reach stations above five hundred meters, it may be necessary to shunt the three plate condenser with a .0001 mfd. fixed condenser, which can be removed for shorter waves.

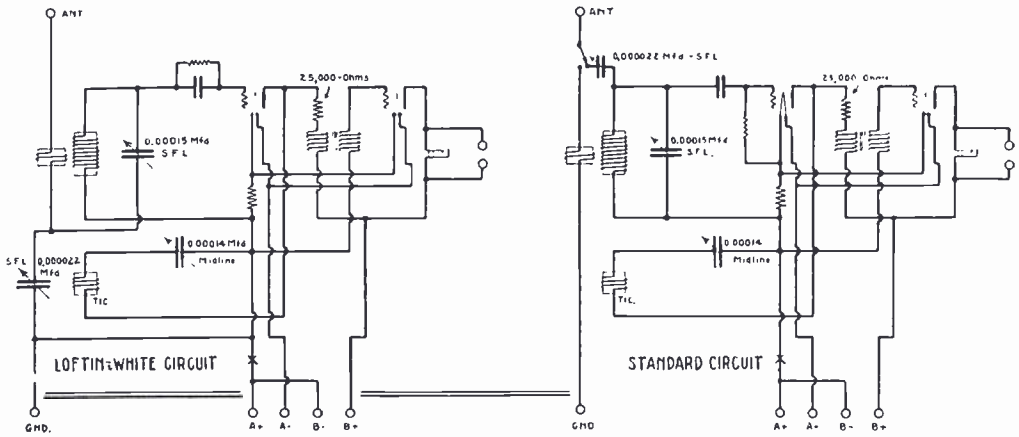
When this system is used, the grid leak can advantageously be shunted around the grid condenser in the usual manner, instead of returning to the filament as in the original circuit.

Comparative operation, using an audibility meter, shows an increase in signal strength of from eight to sixteen times on the upper edge of each band.

Figure 1 shows the original circuit, and Figure 2 the improved circuit. It will be noticed that no additional parts are required beyond those originally specified. A list of these follows:

1 Bakelite panel 7 in. x 18 in. x ¼ in.
1 Bakelite sub-panel 7 in. x 15 in.
L1, L2, L3—Set of Aero Coils.

*Allen D. Cardwell Mfg. Corp.



Circuit diagram of the Loftin-White system as applied to the New Day Set. Few changes in wiring are necessary

C1 Cardwell condenser, Type 191-D or 613-A.

C2 Cardwell condenser, Type 192-D or 168-E.

C3 Cardwell condenser, Type 167-E.

C4 Electrad fixed condenser, capacity .0002 mfd.

R1 Electrad metallic grid leak, 9 or 10 megohms, with mount.

R2 Electrad metallic grid leak, 25,000 ohms, with mount.

R3 Amperite, type 112, with mount.

T1 American De Luxe, first stage transformer.

6 Eby engraved binding posts.

1 Electrad filament switch.

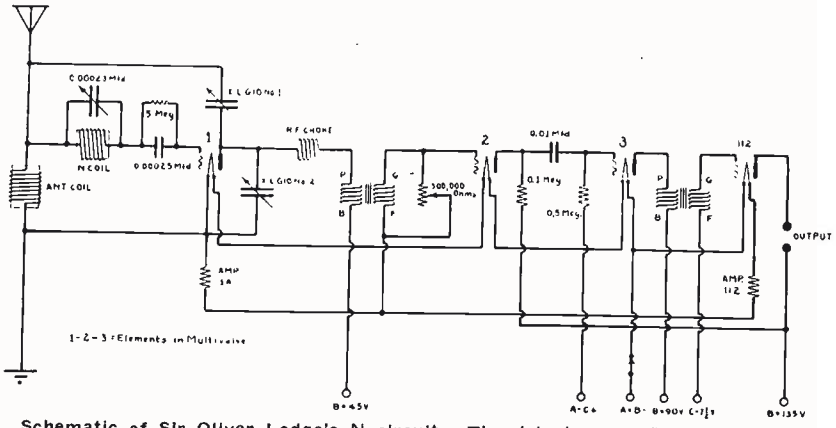
1 Marco 360 dial.

1 Pr. sub-panel brackets.

2 Marco rheostat dials.

1 Electrad single circuit jack.

2 Air-Gap sockets.



Schematic of Sir Oliver Lodge's N circuit. The detector and first two stages of audio are in one tube. The third audio stage uses a separate power tube. Only one control is required for tuning

Lodge's New N Circuit

Authoritative circuit data and constants for this single control, non-radiating receiver, using a multivalve—By A. J. Haynes*

GREAT men, it seems, have a happy faculty of arousing controversy and discussion. Whether it be in radio, or some other field of scientific research, a revolutionary, or semi-revolutionary achievement by an outstanding scientist brings forth a veritable storm of praise and protest. Ever since its introduction in England, where it has enjoyed a tremendous sale and popularity, the Sir Oliver Lodge N Circuit has resulted in many interesting and varied opinions as to its merits from radio engineers and experimenters in America.

There have been six or eight articles here on the theoretical side of the circuit. But it would appear that none of those who have passed upon the N Circuit have had first hand information available, nor have they actually built the receiver and had it operating. From the technical data published in this country, it is worthy of note that the leading article, which includes four diagrams, offers no circuit values or constants whatever. Still other writers go so far as to imply that the N Circuit is absolutely worthless for use in this country. But most enlightening of all is the point that none of these American critics of the Oliver Lodge N Circuit are entirely correct in their fundamental circuits or in the constants used therein.

Complete Data on The N Circuit

The N circuit, as you undoubtedly know, was designed by the eminent British scientist, Sir Oliver Lodge, originator of tuning. It is an English circuit, designed and developed entirely on the other side of the Atlantic. The subject of the N circuit in general, and the American controversy centered about it, has interested the writer for some time. So he decided to investigate for himself at first hand; to find out just what the N circuit was and how well it worked.

The logical place to start was England and Sir Oliver Lodge. A cablegram and two weeks waiting brought an accurate and authentic schematic diagram of the circuit from the English concern controlling the N circuit rights. Two weeks more and we had an English model of Sir Oliver Lodge's receiver which caused a mild sensation in England, and which so many English radio owners are using with outstanding success. The circuit data and the receiver from the other side bear the endorsement of Sir Oliver Lodge in accompanying descriptive matter. So here at last is the complete and entire story of the famous N circuit!

Fundamentals of N Circuit

Figure 1 shows a schematic diagram of the Lodge N circuit, which while fundamentally the English circuit, is worked out to meet conditions in this country. It gives the correct constants, and uses apparatus readily available in America. To the best of the writer's knowledge this is the first absolutely correct and practical working diagram which has appeared in this country. It has been checked against the English specifications for the circuit, and is offered in a form that any radio evperimenter can readily build and try for himself.

Ever since the introduction of the N circuit, American radio fans have asked the questions: "What is this N circuit? How does it differ from our circuits?" In other words, what is the reason or excuse for it?

There is a real purpose and reason behind the N circuit as there is behind anything which a true scientist produces. In the first place, the designer has given us a circuit which is obviously very simple to build and to operate. Disregarding for a moment the audio end, which is a part of any set, the N circuit proper consists of two inductances, two adjustable fixed condensers, and one variable condenser with which all tuning is done.

With this simple collection of apparatus, Sir Oliver has given us a circuit which is truly remarkable. Its outstanding feature is perhaps selectivity. As a first contribution he has given us with one tube the sharp tuning and knife-like selectivity of a good seven or eight tube super-heterodyne.

Uniform Sensitivity Over the Broadcast Band

The second unique feature which the N circuit offers is uniform sensitivity over the entire wave band. This is accomplished primarily by means of the two adjustable fixed condensers. This is worked out by striking a proper capacity between these two condensers. This is a simple adjustment, made after the set is connected to the antenna with which it is to be used. When properly adjusted, the set will not oscillate, nor will any howls or squeals be caused in tuning.

When we realize with what a simple group of parts these two feats are accomplished, we must acknowledge that the designer has really attained astonishing results.

The N Circuit is truly a one control receiver, if ever there was one. There are no trimmers, no side adjustments; nothing but one vernier dial that brings in the station with a sharp click or snap such as you get when tuning a good super-heterodyne.

Important Points

Three or four points should be emphasized for the man who plans to construct the N Circuit. The first is that the specifications for parts are im-

* Complete construction article to be published in RADIO MECHANICS.

portant. This is particularly true of the antenna and N Coils and the .00023 N Condenser. Other parts for the circuit you may be able to substitute for, provided you use equally good apparatus of identical characteristics.

In working out the constants for the N Circuit here and finding apparatus suitable and readily accessible, the writer has gone to considerable trouble. The circuit with the specifications shown in the diagram and list of parts works extremely well. It can be wired in two or two and a half hours by one with a fairly good hand and eye for wiring.

Proper inductance values, correct condenser capacity, proper balancing condensers in the antenna and ground, and lastly correct balancing of the circuit: these are really the things that determine the efficiency of the completed N circuit.

We are planning a construction article for Radio Mechanics, to be run on this new circuit. In this article, complete plans and specifications will be given, including all the necessary dimensions and layouts. A definite announcement will be made in the next issue.

The parts used in the Lodge N Circuit with the Multivalve, are as follows:

1 Precision N coil.
1 Precision antenna coil.
1 Precision type N. R. F. Choke.
1 Precision type N variable condenser.
2 X-L Variodensers type G-10.
1 Electrad Royalty resistance, 500,000 ohms, type L.
2 Samson audio frequency transformers.
1 Electrad filament switch.
2 Pacent cushion sockets.
1 Amperite, 6 volt, ¼ amp.
1 Amperite, 6 volt, ½ amp.
1 Electrad double mounting.
1 Electrad .01 fixed condenser.
1 Electrad .00025 mfd. grid condenser with leak mounting.
1 Electrad 5 meg. grid leak.
1 Electrad .1 resistor.
1 Electrad .5 resistor.
1 Silver-Marshall vernier dial.
1 7 x 14 inch Bakelite panel.
1 7 x 13 inch wood baseboard.
8 Fahnestock metal clips for battery connections.
1 Cleartron Multivalve.
1 Cleartron CTX 112 power tube, or equivalent.

Trend of Radio Power Devices

A Discussion of Filament and Plate Power Sources—
*By Dr. E. W. Engle**

NOW let us consider power supply devices. A visit to the various radio shows, the past fall, showed the increasing importance of power devices in the industry. For the A or filament supply we still have six-volt storage battery paramount. In appearance it has improved from the somewhat messy automobile battery type to a somewhat smaller size, resplendent in glass or moulded rubber, but still the old dependable lead storage battery. It will probably, as the basic unit, continue to hold its place for some years. For radio use the older high rate battery chargers have lost popularity and now either the noiseless trickle charger, the two to three ampere charger or combinations of the two are used. Trickle chargers are left permanently attached to the lamp socket and may or may not have provision for being shut off from the battery when the set is in operation. The present tendency is towards the use of an automatic cut-off switch operated from the filament switch of the set. The bulb and electrolytic types of chargers are now most popular. A newcomer in the field, mainly experimental so far, is the contact type. All of these types are to be had in combination with the battery, and as such are marketed by the leading battery manufacturers. The excellent sales and service stations established throughout the country for the automobile industry will doubtless further the sale of these to the radio field and be a distinct aid in maintaining their popularity.

There have appeared this season mainly in a small way numerous devices designed to do away with the filament battery and allow of direct operation from the lamp socket. Many of these utilize a storage battery of some type. Usually they consist of a rectifier similar to that used in battery chargers, combined with a filter circuit of choke coil, small battery or electrolytic condenser. While still largely experimental these devices offer possibilities for the future and their further development will be awaited with much interest. Interest on the part of the set manufacturer towards constructing sets with series filaments will do much to simplify the economics of the lamp socket A battery eliminator.

As distinct from supplying the set as a whole power amplifier units are offered this season utilizing alternating current on the filaments of the tubes.

For the B or plate current supply the dry battery was highly satisfactory in the days of sets with few tubes and low current consumption. With the coming of multitube sets the plate drain became higher and along with the dry batteries there were offered the wet storage B batteries. The many complications relating to the care and maintenance of these prevented their continued popularity and they are no longer a factor. Plate or B current supply devices operating from the lamp socket with battery made their appearance three seasons ago and due to their ability to meet the increasing current requirements of tubes and set have achieved a definite place for themselves. This season has seen their enormously increasing popularity. It may be said that no set manufacturer can safely put a set on the market without first satisfying himself that its characteristics will permit of its satisfactory operation with the better of the plate supply units. As with the tube manufacturers it is necessary that the power supply manufacturers and the set manufacturers work closely together to the end that the complete installation will be properly balanced.

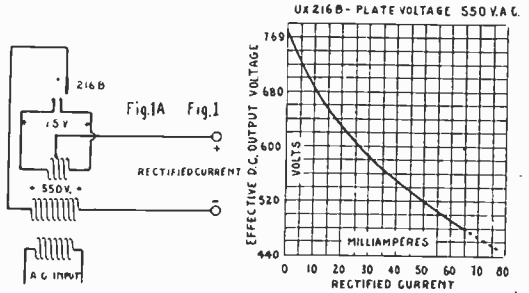
Dry B batteries are still sold competitively with the lamp socket devices for such sets whose current consumption is not too high. They will continue to be a factor even where lamp socket current is available and are to be regarded as necessary where electrical power is not at hand.

Various combinations of power units are available, and are becoming increasingly popular as they make for simplicity of operation. Such combinations usually include the B supply with the A charger, and the B supply with the charger and A battery. In some instances the A and B supply devices are made integral with the set which when feasible is to be regarded as most desirable. There is at present a very definite desire on the part of many set manufacturers to incorporate the power supply in their next season's models.

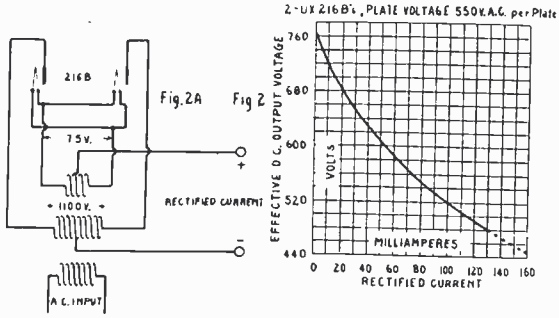
Advance in loud speaker design and manufacture has been distinct and definite. While we still have many of the horns of a few years ago and they will continue to have their adherents the greatest present popularity has been obtained by the cone type speakers. The larger cones bring out the lower notes to a much greater degree than the usual horn type. It may, however, be premature to state that similar results cannot be had with the latter type. For a most pleasing reception a combination of the two is often declared most desirable. Problems involved in sound reproduction have brought the telephone, radio and phonograph interests in close cooperation and we may feel confident this phase will be developed along with the others discussed. All to the end that the final complete installation in the home will result in a pleased and enthusiastic user.

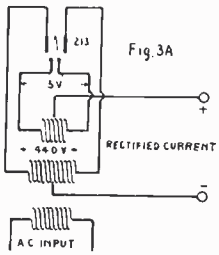
* Chief Engineer, Fansteel Products Co., Inc.

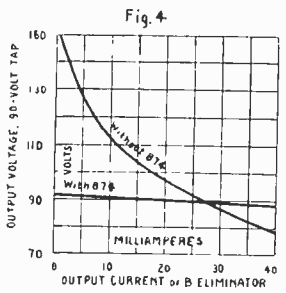
RECTIFYING CIRCUITS AND OUTPUT VOLTAGE CURVES

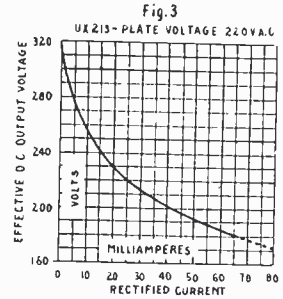


216 B AND 213 TUBES









The story at a glance. These charts can be used as a basis for calculating the values of the component parts of a power unit

Rectifier Characteristics

Official data of interest in connection with rectifying and voltage regulating tubes

THE voltage of a storage battery is a relatively constant and fixed quantity. Likewise is the voltage of a dry battery. In most rectifying systems, however, there is a considerable variation in voltage depending upon the current supplied. The Effective DC Output Voltage of a rectifying system will vary according to:

1. Voltage characteristics of the power transformer.

2. Internal Resistance of Rectifying System including effective plate resistance of rectifying tube.

Since both of the above vary in a certain relation to the current drain from the rectifying system, a curve may be used to show effective Rectified Output Voltage plotted against Rectified Current (D. C.) supplied. The accuracy of such a curve cannot be guaranteed when it is adopted for general use, as the characteristics of different power transformers vary considerably. Nevertheless, since the characteristics of the rectifying tube predominate in determining the available D. C. Voltage at different current drains, the accompanying curves give sufficient accuracy for the requirements of most experimenters.

Note.—It should be remembered that the voltage drop across some form of filter system (Milliamperes/1000 X Ohms resistance of filter system) must generally be subtracted from the Rectified Output Voltage to obtain the useful Rectified and Filtered D. C. Voltage.

Practically all Rectifying Systems such as are used in "B" Eliminators have a so-called drooping voltage characteristic. As the current drain on the typical rectifier is increased, the voltage at which this current is supplied decreases rapidly. Conversely, the D.C. Voltage rises to an abnormally high value when the current drain becomes light.

Radiotron UX-874 was developed to provide a means of regulation by which the output voltage of "B" Eliminators could be held approximately constant regardless of different current drains. When the voltage across its elements tends to rise above 90 volts, the current which it draws increases rapidly, thereby increasing the total current drain on the rectifying system and counteracting the tendency of the "B" Eliminator Output Voltage to rise. Conversely, when the voltage tends to fall, the current drawn by the UX-874 decreases, decreasing the total current drain on the rectifying system and thus counteracting the tendency of the "B" Eliminator Output Voltage to fall. The current drain of Radiotron UX-874 will vary from 10 to 50 milliamperes in maintaining the voltage across its terminals at 90 volts.

Sufficient series resistance must be included in the circuit to prevent a current in excess of 50 milliamperes from flowing thru Radiotron UX-874 when no current is being drawn from the eliminator. It will often be found that the internal resistance of the rectifying system together with the resistance of the filter choke is sufficient for this. An incidental advantage of the UX-874 is that it permits the use of an efficient high resistance choke coil in the filter system. The normal action of the UX-874 in maintaining constant voltage also assists in the suppression of any A.C. hum that may be present.

The nominal rating of the UX-874 is 90 volts. When it is desired to regulate larger voltages, two of these Radiotrons may be connected in series giving a regulated voltage of 180.

The accompanying diagram indicates graphically the variation in output voltage of a typical "B" Eliminator with and without the voltage regulating tube.

A number of interesting facts are revealed by the charts. Fig. 1 shows the output in milliamperes of a UX 216-B plotted against the effective D.C. output voltage of the rectifying system. Tracing the course of this curve, we find that the output is about 600 volts at 25 mils. However, a UX 210 tube is rated at a 22 mil drain, with its maximum rating 425 volts on the plate. Therefore, in cases where a UX 216-B supplies the plate voltage for the UX 210, and no B supply is drawn for the receiver, we can conclude that it is desirable to cut down the output of the rectifier system by means of a suitable by-pass or series resistance.

The UX-216-B is the best tube to employ when it is desired to use high voltages, as in those cases where the UX 210 is used for the power amplifier. The UX 210 can be recommended as the best tube to use when maximum volume and the finest quality of reproduction are desired.

Fig. 2 is a curve similar to Fig. 1, except that it is plotted for two UX-216 Bs, used in a full wave circuit. It will be noticed that the output volt-

age is the same as for the half wave rectifier, but that the rectified current has doubled. This current, being more nearly continuous, is more easily smoothed out by the filter.

This circuit is a very useful one to employ when it is desired to draw large currents from the eliminator, as when the output is used for lighting the filaments of 199 tubes, wired in series. In such a case, ample power is available for A, B, and C power to an entire receiver, including a UX 210 in the power audio stage.

Fig. 3 shows the rectified current output of a UX-213 rectifier, plotted against effective D.C. output voltage. From this, it can be seen that the maximum output is 180 volts at 65 milliamperes, which is more than ample for B supply to any receiver, including a UX-171 tube in the power stage.

This rectifier is to be recommended for B eliminators, when it is desired to use the UX 120, 112, or 171 power tubes. These tubes provide ample volume and handling capacity for ordinary home use.

Fig. 4 shows the output voltage of the 90 volt tap on a typical B eliminator, with and without the voltage regulating tube UX 874. By these two curves, the importance of using the voltage regulating tube is readily understood.

An ideal combination, for a B eliminator and power amplifier, would incorporate the following tubes:

> The UX 213 as rectifier; two UX 874 glow tubes, wired in series, to hold the entire "B" Voltage supply constant, and the UX 171 for the power amplifier with suitable loud-speaker coupling system.

With such a combination, we have every feature to be desired in connection with B eliminators and power amplifiers. The 171 tube operates at its maximum plate voltage of 180, and the two glow tubes assure that this voltage will be constant at all times. In addition, the common junction of the two glow tubes can be relied upon to deliver 90 volts constantly. Forty-five Volts for detection may be secured from the junction of a 25,000-ohm and a 50,000-ohm resistor connected in series and respectively from the negative to the positive 180 volt output terminals. Both regulator tubes will assist in maintaining this voltage constant.

An eliminator, such as the one described, will perform excellently anywhere regardless of the conditions encountered. Ordinary voltage fluctuations in the line do not affect the output of such a device, and the poor line conditions often found in rural communities will no longer be a disadvantage.

Radiotrons UV-876 and UV-886 are current regulators (Ballast tubes) designed to maintain constant current flow and thus insure constant power input to A.C. operated receivers. As they absorb the voltage variations of the line, they hold the receiving tube voltages virtually constant.

The operating currents of the UV-876 and UV-886 are 1.7 and 2.05 amperes respectively. At normal operating current the average voltage drop across each tube is 50 volts. This may vary down to 40 volts or up to 60 volts in maintaining constant current flow. Thus a line voltage variation of 10 volts in either direction can be sustained without appreciable change in current.

When the normal current of the primary of the power transformer is lower than 1.7 or 2.05 amperes, a compensating resistance may be shunted across the primary. The operating voltage of the primary should be just 50 volts below the normal voltage of the A. C. line. When the operating voltage of the primary is lower than this amount, a compensating resistance may be connected in series.

Tuned R. F. Circuit Damping

*Presenting data on a new device which regulates phase displacement in plate circuit of R. F. tubes—By Arthur Moss**

IN RADIO frequency amplification devices the transfer of energy from one stage to the subsequent one is generally accomplished by means of a tuned radio frequency transformer. Such a transformer consists of an untuned primary of a limited number of turns, generally from six to twelve, and a secondary which can be tuned to different frequencies by means of a variable condenser.

The plate of the vacuum tube is then connected directly to one of the terminals of the primary whose other terminal is connected to the positive terminal of the B battery.

It will be clearly seen that when using this particular arrangement the plate of the vacuum tube works into a reactance which consists largely of an inductive reactance only. This inductive reactance consists (a) of the self-inductance of the primary, (b) of the reflected inductance from the secondary into the primary. We can therefore say that the reactance of the plate circuit is purely inductive and that therefore the primary acts more or less like a choke coil.

Now, it is a generally known fact that the particular property of an inductance is that it causes the voltage of an alternating current to precede the current. In other words, when the plate current of the vacuum tube undergoes a change due to the action of the grid the voltage variations across the inductance will precede the current fluctuations. Theoretically we can approach a difference of ninety degrees, but in practice, however, this is impossible. From this it follows that if the voltage fluctuations precede the current a certain number of degrees approaching ninety, the plate potential will vary accordingly. This variation of plate potential reacts, as is generally known, upon the grid of the vacuum tube due to the interelement capacity between plate and grid.

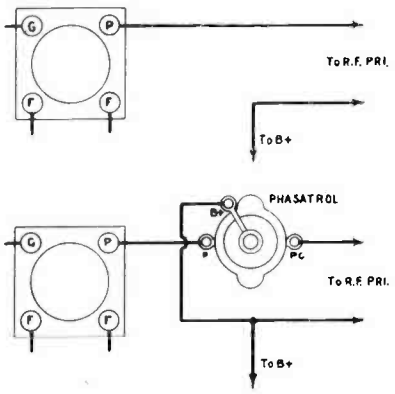
However, it is also known that a capacitance gives a phase displacement amounting to ninety degrees and in fact, the potential lags a certain number of degrees behind the current which again can approach ninety degrees

A close-up of the Phasatrol. The device is adapted for subpanel mounting, and the adjustment is made through the hollow mounting shaft

* Electrad, Inc.

theoretically. Therefore, the impulse upon the grid from the plate due to the current variations in the plate circuit will experience a lag of ninety degrees and an advance of approximately ninety degrees. In other words, the impulse will coincide with the original signal impulse upon the grid and therefore the signal impulse or disturbance of the grid will be reinforced, which then gives rise to violent oscillations, or at least regeneration.

If it were possible in radio frequency amplifiers to cause by some means or other that the actual impulse from the plate upon the grid shows a phase difference approaching ninety degrees with the original disturbance, it is clear that no oscillations would be



This diagram indicates the method of connecting the Phasatrol into the circuit

created because with such a phase difference there is no continuous reinforcement of the original impulse.

The Phasatrol fulfills this condition more or less in an ideal manner. Its principal parts are a condenser and a resistance, the condenser being placed in series with the plate inductance and the resistance shunted across the two of them. The very first function of the resistance is to supply energy or a path for the energy to the plate of the amplifier tube.

Due to the fact that the plate circuit now contains a capacitance and an inductance in series, it will be seen that the plate current will experience the same phenomena which we have explained before, but the result is that the plate potential variations approximately coincide or are in phase with the plate current variations due to the counteraction of inductance and capacity.

Of course, part of the radio frequency energy will flow over the resistance, but due to the fact that this resistance is a pure non-inductive and non-capacitive resistance, it does not give rise to any phase displacement of voltages and therefore by itself cannot give rise to oscillation phenomena.

We see then that by the insertion of the Phasatrol we obtain the result that the plate voltage variations are almost exactly in phase with the plate current variations. Under these circumstances then, the impulses from plate to grid will experience a phase displacement of ninety degrees; in fact the impulse upon the grid will be approximately ninety degrees out of phase with the original disturbance upon the grid, and as we have explained before, such an interaction between plate and grid does not give rise to oscillation, due to the fact of its phase difference.

It should be clear that the device should work in an almost ideal manner if there were no stray coupling between circuits, which is a second reason for oscillations being set up in radio frequency amplifiers. It would be quite possible in such a case to make the resistance quite high, when the tube would work as a voltage amplifier device and varied voltages would appear across the resistance. These voltage variations in turn would cause radio frequency currents to flow over the shunt circuit constituted by capacitance and inductance and therefore the device would be completely free from any tendency to cause oscillations in the system.

Frequency Selectivity

Field measurements disclose interesting characteristics of reception in city areas

THE manufacturers of receiving apparatus and parts and the service man and dealer will be better equipped to handle their equipment more intelligently by becoming acquainted with the problems and difficulties which the broadcaster has to overcome and his view of receiving instruments. An excellent paper in this field has been prepared by Lloyd Espenschied and presented before the Institute of Electrical Engineers, and published in the January issue of the A. I. E. E. Journal.

"A definite correlation is required between the broadcast transmitting station and each of the receivers served. This is evident from the following:

"1. The transmitter should put into the transmitting medium, without distortion, all of the wave band components required and no others.

"2. The transmitting medium should be capable of delivering to the receiver an undistorted wave band, with sufficient strength to enable the received waves to stand well above the level of the ever present interfering waves.

"3. Finally, the receiving set should pass with the necessary volume all of the wave components required to produce the program signal and should sharply exclude all others.

"The rapid apparatus development borne in by the vacuum tube has brought the art to the point where it is now physically possible to meet quite fully the receiving requirements. The apparatus development, in fact, has outstripped our knowledge of the transmitting medium itself, and we are now in the position of possessing apparatus possibilities without knowing very definitely the limitations and requirements placed upon their use by the intermediate link.

Character of Broadcast Transmission

"Recent researches make it seem clear that radio transmission involves wave components of two types; one which delivers directly to the receiving area immediately surrounding a broadcast station a field capable of giving a reliable high grade reception; and another transmitted through the higher altitudes which permits distant reception but not with the reliability and freedom from interference required of high grade reproduction."

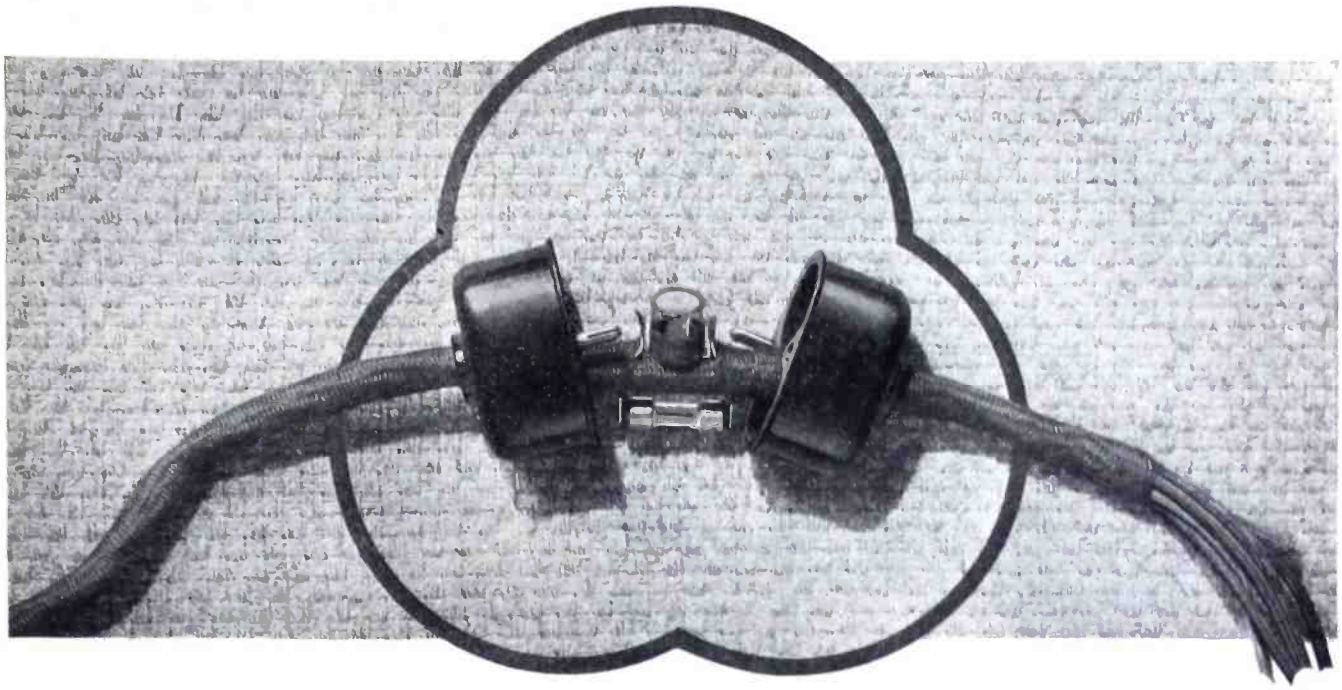
The author gives results of field measurements made in the New York metropolitan area and Washington, D. C. It was observed that fading began between 50 and 100 miles from the stations. Very good reception was obtained with a field strength of 10,000 micro-volts per meter, whereas unreliable distance reception occurred with about 100 micro-volts per meter.

Of special interest is the conclusion reached by the author from field measurements, wherein he states that the reliable high quality program range of a 5-kw. station is measured in tens of miles rather than hundreds. This leads him to conclude that higher power transmitting stations are a necessity.

Receiving in Apartment Houses

"The surveys were made generally in the streets and open places. They do not disclose the details of field distribution in the immediate vicinity of a receiver. Perhaps the most difficult situation is that of the large apartment house, particularly where it is desired to receive by means of an indoor antenna.

"The results of a few observations upon signal strength within two steel structure buildings show the interior field to be reduced to as low as a few per cent of that outside the buildings. For outside rooms, the field strength near the window was found to be about eight times that further in the room. Such severe shielding effects obviously call for picking up the wave energy outside the building and conducting it to the receiving sets by wire circuits, preferably by shielded circuits, in order to protect against local interference. That is, it is preferable to use an outside antenna and shield the individual R. F. circuits."



Belden fused radio battery cord, with Bakelite molded fuse cover.
Made by Belden Mfg. Co., Chicago

A fuse housing of Bakelite Molded

Dielectric strength and fine appearance were required in the material used for the housing of the Belden fused radio battery cord. Both were obtained in Bakelite Molded.

Bakelite Housing Closed

The two parts of this housing are completed in a single molding operation, with metal friction pins solidly embedded in the Bakelite. The high lustre is acquired in the mold, and no buffing nor finishing is necessary.

Radio engineers and manufacturers are constantly finding new uses for Bakelite, because it not only possesses the insulating properties essential for radio service, but is also readily molded with extreme accuracy to any desired form.

Bakelite engineers and research laboratories welcome opportunities to cooperate in applying the advantages and economies of Bakelite to the particular needs of any manufacturer. Write for Booklet 38, "Bakelite Molded."

BAKELITE CORPORATION

247 Park Ave., New York, N.Y. Chicago Office, 636 W. 22nd St.

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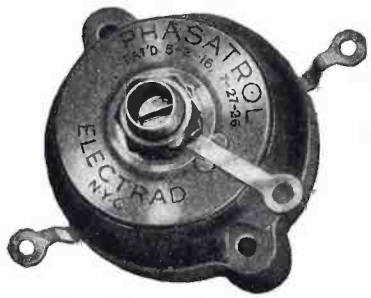
"The registered Trade Mark and Symbol shown above may be used only on products made from materials manufactured by Bakelite Corporation. Under the capital "B" is the numerical sign for infinity, or unlimited quantity. It symbolizes the infinite number of present and future uses of Bakelite Corporation's products."

With the Manufacturers

Current news about the activities and plans of the radio manufacturers and concerns which make things used by the industry

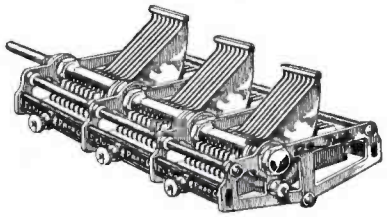
Electrad

Electrad, Incorporated, 428 Broadway, New York City, is making a new device known as the Phasatrol. The Phasatrol is a combination resistance and capacity, which is designed to be inserted in the plate circuits of radio



The Phasatrol provides a new method of preventing oscillation in R.F. amplifiers

frequency amplifying tubes. An adjustment is provided on the device, and when once set, oscillation in the R. F. amplifier is prevented over the entire broadcast band.



The De Jur triple condenser is a well matched unit for single control circuits

De Jur

De Jur Products Company, 199 Lafayette St., New York City, is manufacturing a triple condenser. This unit is designed for use in single control receivers. Each unit in the gang is calibrated and tested for alignment and spacing. The stator plates are fastened outside of the electrostatic field by moulded insulation of Bakelite. A spring phosphor-bronze pig-tail makes a direct electrical connection from the rotor to the frame.

Continental

The Continental Corporation, 179 West Washington, Chicago, is manufacturing a new copper shielded tube. This tube is copper shielded from top to base, and the copper shield is grounded to the negative A terminal. The interior is insulated with a soft cushion which prevents vibration periods. The filament is thorium impregnated, so that the tube can be reactivated. The list price is $2.50.

The new Continental tube is completely copper shielded

Moulded Products

The Moulded Products Corporation, 549 West 52nd St., New York City, is manufacturing the Strongson copper shielded tubes. These tubes are copper plated, and this plating is grounded to the negative filament prong. The copper shield is an integral part of the tube itself. The list price of these tubes is $3.50.

The same company makes the Sofrubba socket. All parts of this socket, with the exception of the prongs and the terminals, are moulded from resilient rubber, which checks the vibration of the tube elements and eliminates microphonic noises.

The Sofrubba socket is moulded from resilient rubber

Geo. W. Walker Co.

The Geo. W. Walker Co., 6528 Carnegie Ave., Cleveland, is making an audio control unit. This device consists of three rheostats for base panel mounting and designed to control the detector and two audio tubes.

Victoreen Audio Control Unit

American Electric Incorporates

The Radio Trade will be interested in the announcement being made of the incorporation of the American Electric Company of Chicago who for some time have been engaged extensively in the manufacture of Burns radio apparatus.

The extensive manufacturing facilities and engineering experiences of this Company have now been combined with the like resources of the Monarch Telephone & Manufacturing Company, also of Chicago, who are equally as well known to the telephone and electrical appliance trade.

The organization will now be known as the "American Electric Company, Inc," and will continue at their plant at 64th and State Streets, Chicago. An extensive manufacturing and advertising program has been planned.

With the added resources and increased engineering and sales force they will be in a position to give their trade whatever is required in service and the best possible in equipment.

Myers Tube Corp. Sold

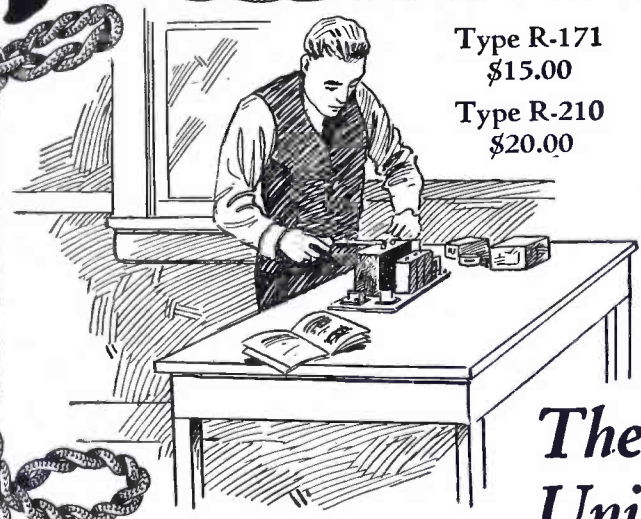
Reorganization of the Myers Radio Tube Corporation of Cleveland has just been announced.

The purchase of the Myers Corporation was closed on January 7 and the new owners already have begun operation of the plant under their own management.

The corporation name, well-known for a number of years throughout the radio industry, will be retained by the new owners, who have announced that the same high standards of manufacture and inspection, which made Myers' tubes favorably known to the trade and the consumers, will be maintained. The plant at Cleveland is being equipped with new and improved equipment to increase production and enable the reorganized corporation to meet the growing demand for high quality radio tubes.

All of the executives of the reorganized corporation have had years of manufacturing and sales experience and have given considerable study to the radio industry and to the trend of consumer demand. The research and engineering departments are headed by well known engineers who have attained unusual success in the radio field.

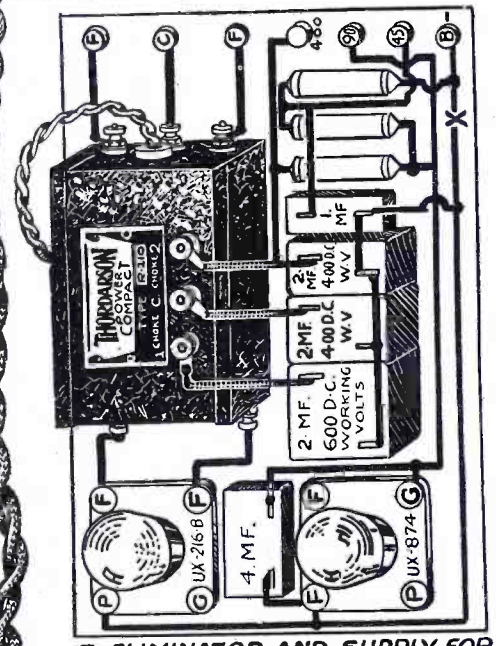
Power from the Light Circuit



Type R-171
$15.00

Type R-210
$20.00

The Complete Foundation Unit for Home Constructed Power Amplifiers



B-ELIMINATOR AND SUPPLY FOR UX-210 POWER AMPLIFIER—

HERE is what you have been waiting for — a silent and efficient power amplifier and B eliminator that will equal anything on the market—one that you can build yourself in less than an hour.

The Thordarson Power Compact is the complete foundation unit for power amplification. It contains: (1) a power supply transformer, (2) two filter choke coils of 30 henries, and (3) a power tube filament supply, tapped at the exact electrical center (an exclusive Thordarson feature), all in one compound filled case.

Two types of Power Compact are available: R-171 is designed for use with power tube UX-171 and Raytheon BH rectifier. Type R-210 is designed for use with power tube UX-210 and UX 216-B rectifier. Each type of compact supplies the proper values of current for maximum efficiency operation of its corresponding power tube.

Packed with each compact is a complete set of instructions which can easily be followed, even by the man with no radio experience.

Remember that when you buy a Thordarson product it is guaranteed and backed by over thirty years' manufacturing of reliable transformers.

For Sale at Good Dealers Everywhere or Direct from Factory

THORDARSON POWER COMPACT

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer specialists since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Chicago, U.S.A.

This Booklet is Yours for the Asking:
"POWER FROM THE LIGHT CIRCUIT"

THORDARSON ELECTRIC MFG. CO.
500 W. Huron St., Chicago, Ill.
Gentlemen:

I would greatly appreciate receiving a copy of your new booklet "Power from the Light Circuit."

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Address.....

City.....State.....

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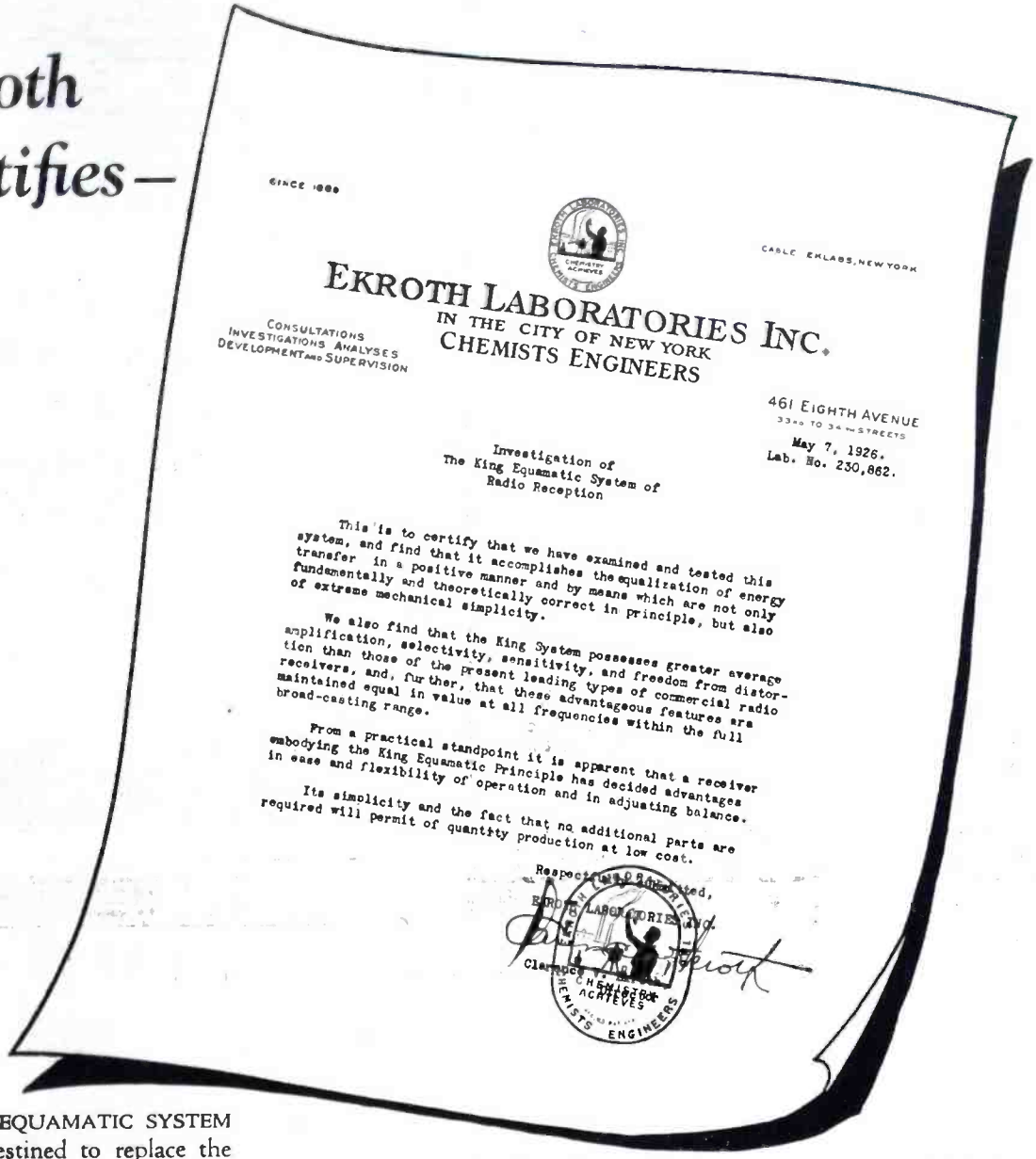
NEXT MONTH

The first official circuit data and constants for a combined Power Amplifier and B Eliminator whose total output is constant regardless of line or load.

Radio Engineering is sold only by subscription—$2.00 yearly.

Radio Hill, Poughkeepsie, N. Y.

Ekroth testifies—



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DEVELOPMENT AND SUPERVISION

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33RD TO 34TH STREETS

May 7, 1926.
Lab. No. 230,862.

Investigation of
The King Equamatic System of
Radio Reception

This is to certify that we have examined and tested this system, and find that it accomplishes the equalization of energy transfer in a positive manner and by means which are not only fundamentally and theoretically correct in principle, but also of extreme mechanical simplicity.

We also find that the King System possesses greater average amplification, selectivity, sensitivity, and freedom from distortion than those of the present leading types of commercial radio receivers, and, further, that these advantageous features are maintained equal in value at all frequencies within the full broad-casting range.

From a practical standpoint it is apparent that a receiver embodying the King Equamatic Principle has decided advantages in ease and flexibility of operation and in adjusting balance.

Its simplicity and the fact that no additional parts are required will permit of quantity production at low cost.

Respectfully Submitted,
EKROTH LABORATORIES INC.
Clarence [illegible]

CHEMISTS ENGINEERS

THE EQUAMATIC SYSTEM is destined to replace the present "losser" methods of control. Once the public recognizes the superiority of radio receivers embodying the Equamatic System, an ever increasing demand is assured.

Licenses for the rights to use the Equamatic System in the manufacture of sets and kits will be issued to a limited number of established radio manufacturers.

Before formulating plans for future production, investigate the exclusive advantages of the Equamatic System. Demonstration and tests may now be arranged by appointment.

THE EQUAMATIC SYSTEM, 10 ARGYLE RD., BROOKLYN, N. Y.

U. S. and Foreign Patents Pending

EQUAMATIC SYSTEM
LICENSED UNDER
KING PATENTS PENDING

ELECTRAD

Every Radio Frequency Set Needs "PHASATROL"

Licensed by Rider Radio Corporation

Pat'd 3-2-'16 7-27-'26

A true balancing device for radio frequency amplifiers.

This is what the radio fans have been waiting for. No fussing with troublesome balancing condensers, no difficulty offsetting coils or transformers, etc., no cussing over radio frequency oscillations—just install PHASATROLS and they will solve these problems in a jiffy.

An extensive advertising campaign, supplemented by wide publicity in the shape of technical articles on PHASATROLS in the various newspapers and radio publications, are creating a big demand for this new device.

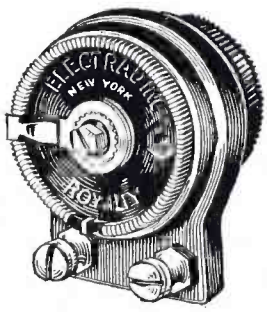
Retailing at $2.75 each, packed six individual cartons to a display container with full instructions for their installation, PHASATROLS sell like hot-cakes. To the dealers who have not yet stocked up, we can give only one piece of advice—if you want prompt delivery so as to meet this demand, order from your jobber TODAY.

Write for free hook-up circular

New Model

ELECTRAD Royalty Variable High Resistances

For Perfect Control of Tone and Volume



Licensed by Technidyne Corporation under U. S. Patent 1593685, July 27, 1926.

Note these important exclusive features:

1.—Resistance element not exposed to any mechanical operation.

2.—Electrical contact made positive by metallic arm on wire-wound strip.

3.—The same resistance is always obtained at the same point.

4.—Resistance value is under control in process of manufacture and does not change in use.

5.—Entire range of resistance is covered with less than a single turn of the knob.

6.—There is no mechanical binding and shaft is turned smoothly over entire range.

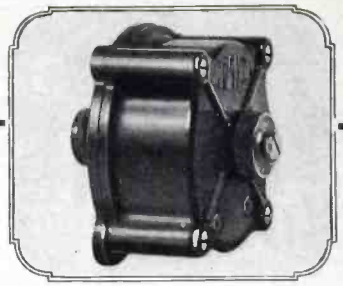
A range for Every Purpose. Type E, $2.00; all other types A-L, $1.50. Canada, $2.10-$3.00.

WRITE FOR FREE HOOK-UP CIRCULAR

175 VARICK STREET

RMA RADIO MANUFACTURERS ASSOCIATION MEMBER

ELECTRAD Inc



The Amplion unit helps any set to give its best performance.

Many set manufacturers have accepted our offer of cooperation—

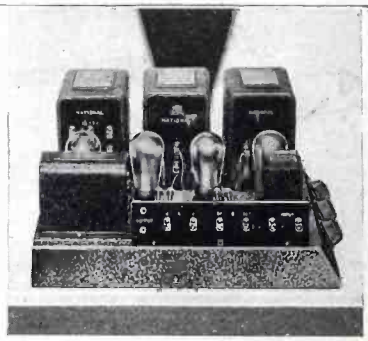
Our engineering staff is at your service for all problems of enclosed units and matching unit to your set electrically.

We will be glad to discuss these matters with you at any time.

The Amplion Corporation of America
Suite W, 280 Madison Ave. New York City

AMPLION

NATIONAL
POWER AMPLIFIER

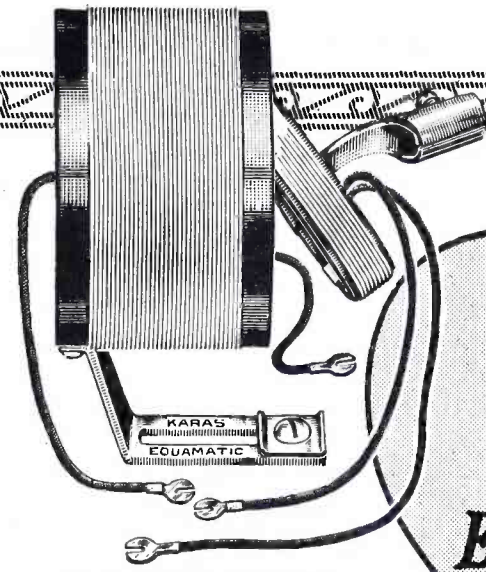


Supplies all B current for your set and C bias for the power tube, and gives any Radio Receiver true quality and fidelity of tone with as great volume as desired. Uses either Raytheon BH or Rectron full-wave rectifying tube.

NATIONAL COMPANY, INC., CAMBRIDGE, MASS.

W. A. Ready, President, makes also B Eliminators, the famous NATIONAL Tuning Units with BROWNING-DRAKE Coils and Transformers, Impedaformers, Velvet-Vernier Dials with or without illumination, and Variable Condensers, including the new model NATIONAL Variable Condensers.

Send for Bulletin 116-E-2



Equamatic System Licensed under King Patents Pending.

One of the three Karas Equamatic Inductance Coils used in the Karas Equamatic 5-Tube Sensation.

The Heart of the Equamatic

100 Coils in 1

THE heart of the Karas Equamatic 5-Tube Sensation is the Karas Equamatic Inductance Coil.

This remarkable achievement is effectively 100 coils in 1. Its continuously variable primary, mounted on the extended shaft of the special Karas Orthometric Condenser, insures the maximum transfer of energy between primary and secondary coils at every wave length setting of the dials.

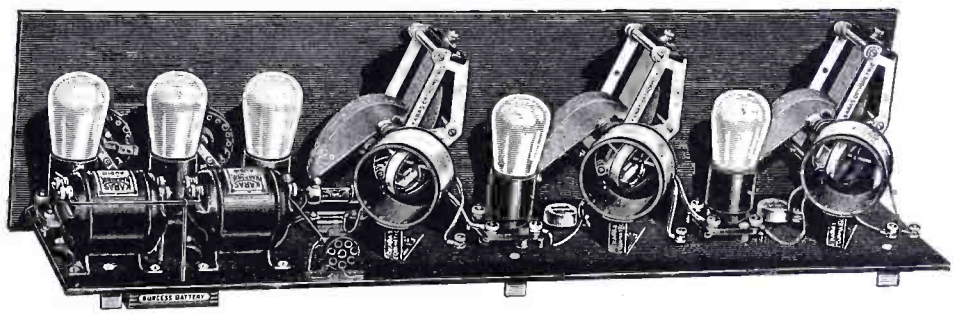
Since impedance varies with frequency, and because the amount of energy transferred from primary to secondary varies with impedance, a greater inductance is needed in a primary coil in order to tune to 600 meters than is required to tune to 200 meters.

This being true, in order to secure maximum efficiency in the transfer of energy between primary and secondary,—that is, 100% efficiency at every wave length setting of the dials—a radio receiving set must either use 100 separate inductances, if such a thing were practical, or it must provide some way of automatically varying the energy transfer—increasing or decreasing the primary inductance as the frequency of the signal varies according to the wavelength. In the Karas Equamatic 5-Tube Sensation this is accomplished in a simple, positive, automatic manner. Each Karas Equamatic Inductance Coil practically becomes 100 coils in 1, and is capable of an almost infinite number of variations in the energy transfer between primary and secondary within the entire broadcast range between 200 and 600 meters.

With 100% efficiency in this all-important part of the circuit you naturally expect marvelous results from a receiver employing these wonderful coils—and you are not disappointed. The Karas Equamatic is a powerful, selective, sweet-toned, sensitive receiver with a remarkable record of performance in every part of the country.

You can easily and quickly build the Karas Equamatic, just as thousands have done and more are doing every day. Your dealer can supply you with the necessary Karas parts and the other standard parts required to build your Equamatic. With each set of three Karas Equamatic Inductance Coils is included a complete manual (which will be sent upon receipt of 10 cents) of simple diagrams and instructions and all of the necessary nuts, screws, binding posts, etc., for assembling your receiver. If your dealer is out of stock of Karas parts, and you are in a hurry, you may order direct from us by filling out and mailing the coupon below. SEND NO MONEY. Simply hand the postman the price of the Karas parts, plus a few cents postage. When you have built this remarkable receiver you will join the vast numbers of Equamatic enthusiasts who tell us that this circuit is the most efficient they ever saw.

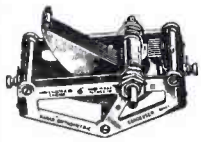
KARAS ELECTRIC CO., 1092 Association Building, Chicago



Karas Equamatic Inductance Coils—Used in the Equamatic 5-Tube Receiver.

The remarkable efficiency of the Karas Equamatic 5-Tube Receiver insofar as energy transfer is concerned is due to the design and positioning of these coils, three of which are used. It will be noted that the primary is fitted with an adjustable sleeve which permits it to be mounted on the extended shaft of the Karas Orthometric Condenser. As the dial is rotated the amount of primary is increased or decreased, at an exact, ever-varying rate, which keeps the radio frequency tubes at the peak of their efficiency—just below the oscillation point. Price, set of 3 coils, with all necessary nuts, screws for building the entire receiver, $12.00.

Karas Orthometric Special Extended Shaft 17-Plate Variable Condensers—Used in the Equamatic.



Three of these dependable, straight frequency line variable condensers are specified for the Equamatic Receiver. These Orthometrics have extended shafts upon which are mounted the adjustable primaries of the Karas Equamatic Inductance Coils. Karas Condensers are all brass, with die stamped frames and plates, the latter being soldered at every point of contact. Karas Orthometrics have the lowest losses known. In addition, the special eccentric shape of Orthometric plates gives a straight frequency curve, with a consequent equal spacing of adjoining stations at 10 kilocycle separations on the dials, exactly as allocated by the government. Price, each, $7.00.

Karas Harmonik All-Stage Ratio Audio Frequency Amplifying Transformers—Used in the Equamatic Receiver.

The powerful volume and the clear, pure, full amplification of Karas Harmonik Transformers are too well known to emphasize. They contribute much to the remarkable performance of the Equamatic because they amplify equally all of the harmonics and overtones of the entire musical scale. Scientifically shielded, perfectly matched, Karas Harmoniks have extraordinary high impedances, and possess extremely low distributed capacity. The tones delivered are natural, never squeaky, harsh or distorted. Price, each, $7.00.

Karas Micrometric Vernier Dials—Used in the Equamatic Receiver.

For extremely selective circuits such as the Equamatic, as well as for supers and regenerative circuits, no other dials give such tuning satisfaction as Karas Micrometrics. Their vernier ratio is 63 to 1. This insures a fineness of tuning which approximates 1-1000th of an inch. We use a special precision gear-train which turns smoothly and evenly, and in which no back lash exists or can ever develop. With Micrometrics you can tune any set so sharply that you can bring in stations you never heard before. Constructed throughout of bakelite, with gold markings. Price, each, $3.50.

KARAS ELECTRIC CO., 1092 Association Building, Chicago
Please send me set of 3 Equamatic Inductance Coils, $12; 3 Special Orthometric Condensers with extended Shafts, $7 each; 3 Micrometric Vernier Dials, $3.50 each; 2 Harmonik Audio Frequency Transformers, $7 each; 2 Equamatic Retard Coils, $1 each; and 3 Equamatic Sub-Panel Brackets, 70c, for which I will pay the postman $60.20 plus postage, upon delivery. It is understood that I have the privilege of returning any of this apparatus for full refund within 30 days if it does not prove entirely satisfactory.

Name.....

Address.....

City..... State.....

If you send cash with order we will ship these parts postpaid.

BROWNING-DRAKE RADIO

SELL The New Browning-Drake Official Kit Set

Designed by

Glenn H. Browning

BROWNING-DRAKE Radio is known to almost every radio fan. Countless radio designs have come and gone since 1923, but Browning-Drake continues to grow in popularity and evokes the same genuine enthusiasm that it did over three years ago. Any development based on such sound scientific research as the Browning-Drake work at Harvard University, was bound to endure.

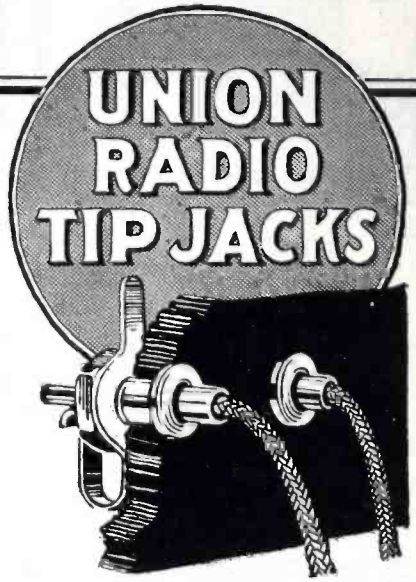
Now for the dealer who wishes to meet the demands of the fans desiring to build their own, Browning-Drake is now offered in a new OFFICIAL design APPROVED by Glenn H. Browning and Dr. Frederick H. Drake. The constructing is made easy by instructions contained essentially in every kit, or presented in booklets sold by the dealer for twenty-five cents.

Every Browning-Drake dealer has made money and every Browning-Drake sale has made a satisfied customer for the dealer. Take advantage of the Browning-Drake opportunity TODAY. If your jobber cannot supply you with the Browning-Drake Corporation Kit, send us his name and address and we will take care of your requirements immediately.

BROWNING-DRAKE CORPORATION

BRIGHTON - - - - MASS.

For Greater Convenience and Beauty



MANY manufacturers of high-grade receiving sets are using Union Radio Tip Jacks as standard equipment because they add saleability at comparatively small cost.

These Jacks make any panel smarter looking as they are neat in design and heavily nickel-plated. Used for battery leads, aerials, ground wires, loud speaker connections, etc., they insure positive contacts and instant insertion or removal of cord tips.

To Dealers

Union Radio Tip Jacks retail profitably at 25c a pair. Fans buy them on sight for all input and output leads. Add this money-making item to your line of parts.

Firmly grip all wires from No. 11 to No. 24 B & S gauge. Three sizes for all panels. Type A (Standard) for 3/16″ to 1/4″ panels. Type B (Special) for panels, cabinet walls and partitions from 5/16″ to 1/2″ thick. Type C (Standard) for panels up to 1/8″ thick. Packed in self-selling cartons of 1/12, 1/2 and 1 gross pairs.

Identification Tags

Hard red fiber ovals marked with proper identifications of battery connections, such as A—, B—, B 67, B 90, etc. Prevent shorting battery or blowing tubes. Packed 100 in box of one designation only. Retail price $1.00. Also in set of 9, retail price 10c.

To All Branches Of The Trade

Send for illustrated circular and samples of these fast selling radio products, and details of our attractive proposition.

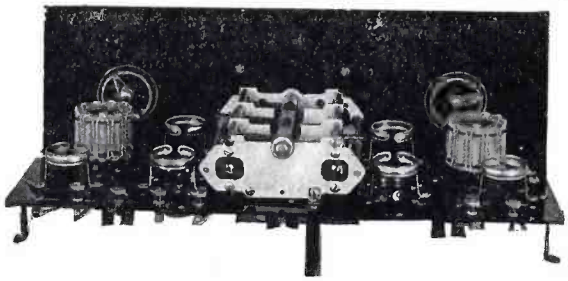
UNION RADIO CORPORATION

124 SUSSEX AVENUE NEWARK N.J.

NEW YORK OFFICE, 40 EAST 34th STREET

PIERCE AIRO

Complete Assembly for a SIX TUBE RESISTANCE-COUPLED SINGLE DIAL RECEIVER



Front and Interior Panel View

Scientifically Perfected and Built

Install the Pierce-Airo Complete Assembly in your own models and save time and expense of manufacturing. It is a mechanically and electrically perfect product. Pierce-Airo fits all standard cabinets and consoles now on the market. It meets the season's demand for simplicity of operation and pure tone by scientifically combining single dial control and resistance-coupled amplification. No live dealer can afford to overlook this unusual opportunity to sell Pierce-Airo Complete Assembly. Let us quote on your requirements TO-DAY.

Pierce-Airo Complete Assembly with a 7 x 18 Processed Bakelite Panel, Ready for Wiring.. **$42.50**

Pierce-Airo Chassis Wired $45.00

Write TO-DAY for Proposition

UNITED SCIENTIFIC LABORATORIES, Inc.
82 Fourth Avenue, New York City

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Chicago
Philadelphia

UNITED SCIEN. LAB. INC.

Branch Offices
Minneapolis
San Francisco
Los Angeles

EBY Binding Posts are specified In 23 Famous Circuits

Almost without exception Radio's leading circuit builders have specified Eby Binding Posts because their experiments have shown them that they are all that binding posts should be—efficient, good-looking and foolproof!

Eby Binding Posts are also the choice of 90% of the leading receiver and accessories manufacturers in America today.

Be sure that it's genuine Eby Binding Posts you get to build any receiver and you will eliminate all possibility of contact trouble.

Browning-Drake
Cockaday LC 27
Hammarlund-Roberts
Infradyne
LaCault LRA
St. James
Varion
Kenneth Harkness KH 27
Victoreen
General Radio 400
Henry-Lyford
Universal
Aero-Dyne
Premier
Thordarson (Power Amp. & "B" Elim.)
All-American R.F. Set
Karas Equamatic
Daven
Samson TC DeLuxe
Aero Coil R.F. Set
AmerTran LC 27 Power Pack
Ultimax
Loftin White

The Eby Socket

The EBY Socket delivers a positive three point wiping contact while the tube is in service. Its ingenious construction allows for interchangeability without damage to the tubes.

THE H. H. EBY MFG. CO.,
4710 Stenton Ave., Phila., Pa.

Bradleystat

PERFECT FILAMENT CONTROL

The Bradleystat provides perfect filament control for all tubes

Provides complete noiseless filament control for all radio tubes without change of connections. Metal parts are nickel plated. One hole mounting. Self-contained switch opens battery circuit when desired.

Allen-Bradley Co.
Electric Controlling Apparatus
288 Greenfield Avenue Milwaukee, Wis.

BUILD the prestige and recognized performance value of Hammarlund Products into your 1927-28 sets and construction kits.

The Hammarlund Engineering Department welcomes the opportunity of working with your staff on special apparatus made to specifications.

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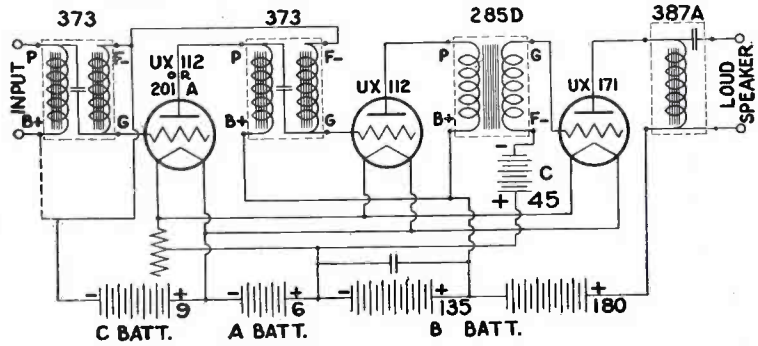
For Better Radio
Hammarlund
PRECISION
PRODUCTS

A NEW Amplifier Unit

that provides for Extremely Faithful Reproduction

SCHEMATIC DIAGRAM
FOR COMBINATION 2 STAGE DOUBLE IMPEDANCE COUPLED
AND 1 STAGE TRANSFORMER COUPLED AMPLIFIER WITH SPEAKER FILTER



Type-373
Double Impedance Coupler
Price $6.50

While the use of double impedances is not new in principle the General Radio Type 373 Double Impedance Coupler is unique in design and performance. To facilitate installation the complete unit, consisting of two impedances and a fixed condenser, is contained within a metal shell. It is connected in precisely the same manner in an audio amplifier circuit as a transformer.

Write for Booklet 373-E which fully describes the design and use of the Type 373.

GENERAL RADIO CO. **Cambridge, 39, Mass.**

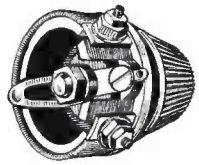
VICTOREEN—

A Super Set Without a Peer

Victoreen
R. F. Transformers

Are especially recommended for their sharp tuning. They are actually tuned to a precision within 1/3 of 1% — a Victoreen feature.
Use No. 170 RF Transformers for regular tubes.
Use No. 171 RF Transformers for dry cell tubes.
Victoreen No. 150 coupling unit is made for use with these transformers.

Victoreen Super Sets are free from oscillation, howls or squeals. Ask your dealer or write to us for blue print and complete information.



Victoreen Rheostat

Zero temperature coefficient. Increased number of turns of wire. Three terminals simplifying wiring. Five resistances, 2, 6, 10, 20, 30 ohms, each $1.20.
Potentialities 200 or 400 ohms, each $1.50.

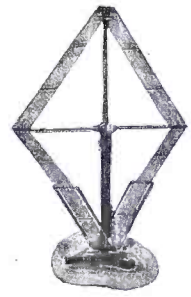
Master Control Unit

A one-dial unit with compensator permits adjustment up to 20 degrees variancy, with a 360 degree vernier motion. Used in circuit employing 2 or more condensers of the same capacity.
Two condenser type—$19.50. Extra condensers, each $4.50.

THE GEO. W. WALKER CO.,
6528 Carnegie Ave., Dept. N. Cleveland, Ohio
Merchandisers of Victoreen Radio Products

TOBE

FOLDING LOOP



Supreme both mechanically and electrically, the TOBE folding loop because of its large size and special Litz wire has unusual pick-up. It is tapped in such a manner that it may be used in whole or in part without dead-ends and is adaptable to loop-regeneration sets or supers. Price $25.00.

The TOBE Vacuum "Tip-on" Grid Leak is the only gridleak sealed in a high vacuum tube, forever safe against change or deterioration. Recommended especially for quality resistance—coupled amplifiers. Made in all values. Look for the sealing tip. No others are genuine.

TOBE

FILTER CONDENSERS

are standard the country over for coupling condensers in resistance and impedance amplifiers, for set by-passing, for filters. In the TOBE Silvered can, with the TOBE trademark.

Tobe Condensers and Resistors are used in the Browning-Drake

Write for price-list E-2

TOBE DEUTSCHMANN CO.
Engineers and Manufacturers of Technical Apparatus
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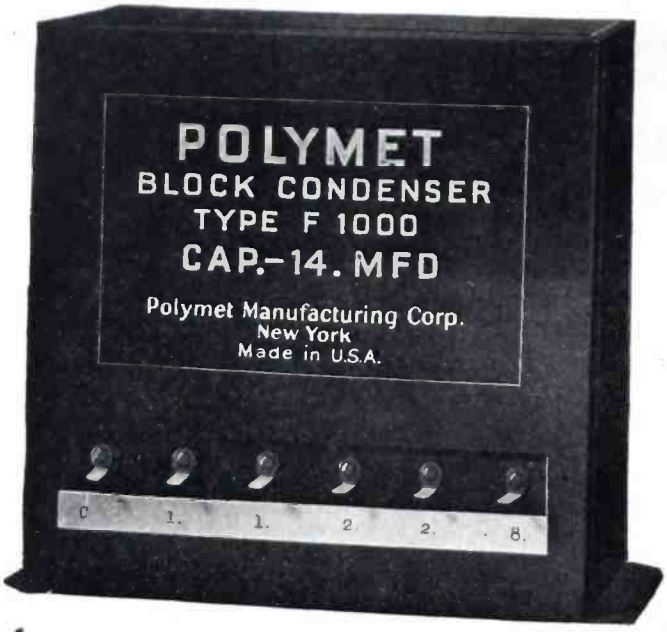
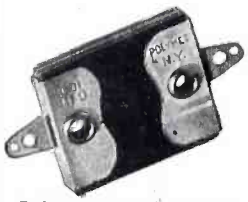
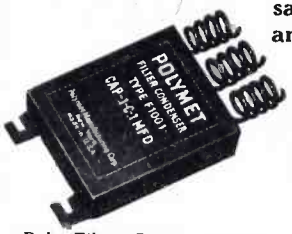


Radio Engineers NEVER Guess —They Know!

Poly By-pass Condensers



Poly Fixed Condensers



Poly Filter Condensers

That's why set manufacturer after set manufacturer — power unit builder after power unit builder, eventually turn to Polymet for condensers.

Polymet Condensers are proving their unqualified superiority every day in the laboratories of these manufacturers. And thousands of Polymet Condensers, embodied in sets and power units, in homes throughout the country, are standing out as primary factors in satisfactory, lasting performance.

We will gladly send you catalog and complete information regarding Polymet Condensers and other Polymet Products on request.

Polymet Manufacturing Corporation
599 H Broadway **New York City**
"World's Largest Manufacturers of Radio Essentials"

POLYMET PRODUCTS

Bradleyleak

THE PERFECT GRID LEAK

Provides a noiseless range of grid leak resistance from ¼ to 10 megohms. Assures most effective grid leak resistance value for *all* tubes. Small grid condenser (0.00025) is separate. Metal parts nickel plated. One hole mounting.

The Bradleyleak may be mounted on either base or panel.

Allen-Bradley Co.
Electric Controlling Apparatus
288 Greenfield Ave. Milwaukee, Wis.

For PERFECT Filament Control

AMPERITE

REG U.S. PAT. OFF.

The "SELF-ADJUSTING" Rheostat

Simplifies set operation. Solves tube control problems. Avoids distortion in reception. Decreases servicing need. Lowers production costs. Write for details.

Radiall Company
50 Franklin St., New York, N. Y.

See That Screw
A screw-driver adjusts an X-L in crowded places

X-L VARIO DENSER

RESULTS in easier tuning, more distance, volume and clarity—greater stability. Indorsed by leading authorities.

Model "N" A slight turn obtains correct tube oscillation on all tuned radio frequency circuits. Neutrodyne, Roberts two tube, Browning-Drake, McMurdo Silver's Knockout, etc., capacity range 1.8 to 20 microfarads. **Price $1.00**

Model "G" with grid clips obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in heterodyne and positive grid bias in all sets. Capacity range Model G-1 .00002 to .0001 M F D. Model G-5 .0001 to .0005 M F D. Model G-10 .0003 to .001 M F D. Details on request. **Price $1.50**

X-L Push Post. Push it down with your thumb, insert wire, remove pressure and wire is firmly held. Releases instantly. **Price 15c**

Seven Push Post Panel permanently marked in white on black insulating panel. In box including soldering lugs, raising bushings and screws for mounting, etc. **Price $1.50**

X-L RADIO LABORATORIES 2423 Lincoln Ave. CHICAGO, ILL.

The Glo-liminator

The first design for an eliminator which supplies constant voltage under all normal loads at 180, 90, and 45 volts, combined with a 171 power amplifier.

See March Radio Engineering

Buyers Directory of Equipment and Apparatus

Readers interested in products not listed in these columns are invited to tell us of their wants, and we will inform the proper manufacturers. Address Readers' Information Bureau. Addresses of these companies can be found in their advertisements—see index on page 598.

ADAPTERS:
Bakelite Corp.

AERIALS, LAMPSOCKET:
Dubilier Condenser Corp.

AMPLIFIERS, RESISTANCE:
Allen-Bradley Co.
Polymet Mfg. Co.

ARRESTERS, LIGHTNING:
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Silver-Marshall, Inc.

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General Radio Co.
National Co.
Thordarson Elec. Mfg. Co.

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COILS, IMPEDANCE:
Dudlo Mfg. Co.

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Hammarlund Mfg. Co.
Karas Electric Co.

COILS, SHORT WAVE:
Hammarlund Mfg. Co.

COILS, TRANSFORMER
Dudlo Mfg. Co.

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Polymet Mfg. Corp.
Sangamo Electric Co.
Tobe Deutschmann Co.

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Electrad, Inc.
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Hammarlund Mfg. Co.

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Karas Electric Co.
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Lynch, Arthur H. Co.
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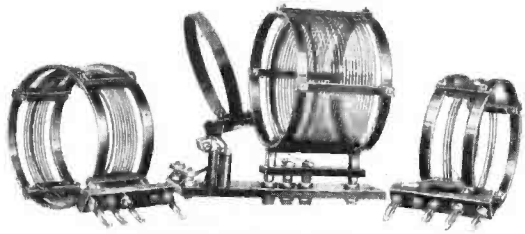
—the Aero Coils that are performing so remarkably!



Range 15-130 meters

Low Wave Tuner Kit—$12.50

This is the supersensitive kit that has performed so wonderfully in bringing in low wave stations from all parts of the world. Completely interchangeable. Has gapless range 15 to 130 meters. Complete with base—$12.50. Interchangeable Coil No. 4, range 125 to 250 meters, $4.00. Coil No. 5, range 235 to 550 meters, $4.00.

Tuned Radio Frequency Kit—$12.00

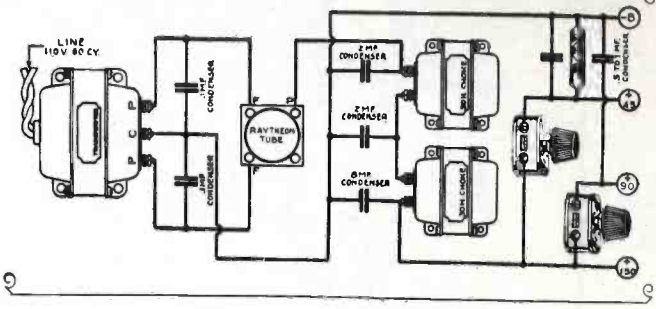
The supersensitive coils composing this kit will improve the performance of any set. Big 8-page, 4-colored layout system (actual size blue prints) and complete instructions for building the Aero-Dyne Receiver free with each kit. Instructions include insert showing how to wire up for a power tube if desired.

Get these coils from your nearest dealer. If he can't supply you, order direct from the factory.

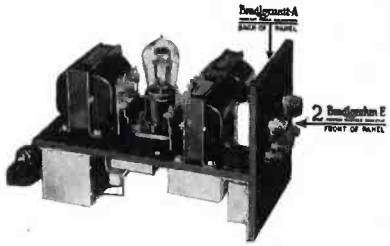
AERO PRODUCTS, INC.

Dept. 17

1772 Wilson Ave. **Chicago, Ill.**



Improve Your B-Eliminator With Allen-Bradley Resistors



WHEN you build a B-Eliminator, be sure that your kit contains Bradleyohm-E for plate voltage control and Bradleyunit-A for fixed resistors. Then you will be assured of perfect plate voltage control.

Bradleyohm-E

PERFECT VARIABLE RESISTOR

This oversize variable resistor is used as standard equipment by leading B-Eliminator manufacturers. The scientifically treated discs in Bradleyohm-E provide stepless, noiseless plate voltage control, and the setting will be maintained indefinitely. Do not experiment with makeshift variable resistors. Ask for Bradleyohm-E in the checkered carton.

Bradleyunit-A

PERFECT FIXED RESISTOR

This solid, molded fixed resistor has no glass or hermetic sealing in its construction. It is a solid unit, with silver-plated end caps, that is not affected by temperature, moisture and age. By all means, use Bradleyunit-A when you need a fixed resistor.

Send for folder "How to Build a B-Eliminator" describing seven popular hookups

ALLEN-BRADLEY COMPANY

288 Greenfield Avenue Milwaukee, Wis.

Use Allen-Bradley Perfect Radio Devices

WILLIAMS PRESS, INC., NEW YORK—ALBANY

QUALITY DONGAN PRODUCTS

A Message to Manufacturers

Today, buyers of radio—receivers, battery eliminators and power amplifiers—insist upon the latest of approved designs and finest quality of performance. To you, the manufacturer, much depends upon your source of supply on parts.

For audio amplification, power amplification and battery elimination the very latest designs are found in Dongan Transformers. Exclusively a manufacturer of high-grade parts Dongan offers the newest improvements in engineering ideas and the extreme quality in construction—at a price within your purchasing requirements.

Allow us to help you to improve your product.

Audio Transformers

A and B Power Parts

Power Amplification Transformers of the Newest Designs

No. 3527

Fans—Eliminate B-Batteries and get more power from your set—improve the tone quality with No. 3527 Unit, a Full Wave Rectifier for use with one UX 213 tube and power amplifier UX 171 tube.

No. 3527 List $15.00

See your dealer or order direct. Other types available—write for booklet.

DONGAN ELECTRIC MANUFACTURING COMPANY
2995-3001 Franklin St.
DETROIT, MICHIGAN

TRANSFORMERS of MERIT for FIFTEEN YEARS